Champaign County
Department of
PLANNING &
ZONING

Brookens Administrative Center
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Urbana, Illinois 61802

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CASE NO. 130-AT-24

SUPPLEMENTAL MEMORANDUM #2
December 12, 2024

Petitioner: Zoning Administrator

Request: Amend the Champaign County Zoning Ordinance to add "Battery Energy Storage System" as a new principal use under the category "Industrial Uses: Electric Power Generating Facilities" and indicate that a Battery Energy Storage System may be authorized by a Special Use Permit in the AG-1 Agriculture, AG-2 Agriculture, B-1 Rural Trade Center, B-4 General Business, I-1 Light Industry and I-2 Heavy Industry Zoning Districts; add requirements and fees for "Battery Energy Storage Systems"; add any required definitions, and make certain other revisions to the Ordinance as detailed in the full legal description in Attachment A.

Location: Unincorporated Champaign County

Time Schedule for Development: As soon as possible

Prepared by: **John Hall**
Zoning Administrator

Charlie Campo
Senior Planner

REVISED AMENDMENT

The Draft Amendment has been revised based on comments received from private sector reviews and a staff review of NFPA 855 and minor editorial corrections. An excerpt of NFPA 855 is included as an attachment.

In the excerpt of NFPA 855 Board members may find Table 9.5.2 Outdoor Stationary ESS Installations (see page 855-20) and Table 9.6.5 Electrochemical ESS Technology-Specific Requirements (see page 855-24) especially helpful as a guide to NFPA 855 requirements. Lithium-ion BESS is the most common but at this time the Draft amendment is intended to accommodate any BESS that is discussed in NFPA 855.

The principal revisions are summarized below:

1. The Special Use Permit requirement has been changed to a required County Board Special Use Permit.

2. The minimum required street setback has been reduced to the basic street setback that applies to all structures.

3. The separation to property lines (Section 6.1.8C.) has been revised in a major way to match the required separations for a PV Solar Farm and this includes a minimum separation of only 10 feet for parcels larger than 10 acres when there is no dwelling or principal structure within 530 feet.

4. Section 6.1.8D.(6) Safety has been revised extensively to incorporate NFPA 855 requirements in a general sense. The principal changes are as follows:
   a. The NFPA 855 requirement for a "Hazard Mitigation Analysis" has been added. The Hazard Mitigation Analysis must be approved by the relevant fire protection district. The Zoning Administrator is to receive a copy of the approved Hazard Mitigation Analysis with the Zoning Use Permit Application.

   b. The NFPA 855 requirement for a "Commissioning Report" prior to the BESS going into operation has been added. Both the relevant fire protection district and the Zoning Administrator are to receive copies of the Commissioning Report.

   c. Access drive requirements have been added. Any part of the TIER-2 BESS must be within 100 feet from an access drive.

   d. NFPA 855 requirements for smoke and fire detection systems have been added. Smoke and fire detection systems are not required for outdoor locations.

   e. NFPA 855 requirements for fire control and suppression (including water availability) have been added. Fire control and suppression (including water availability) are not required for outdoor locations more than 100 feet from other buildings and property lines unless recommended by the relevant fire protection district or otherwise required by the Board.

   f. NFPA 855 requirements for explosion control have been added. NFPA 855 requires explosion control for nearly all BESS.

   g. General NFPA 855 requirements have been added for TIER-2 BESS proposed to be in or on a building.

   h. NFPA 855 requirements for "Remediation Measures" have been added. NFPA 855 requires the BESS owner to provide authorized service personnel to assist emergency responders and allows for the "authority having jurisdiction" to also require the owner to provide "hazard support personnel" to monitor the BESS for possible ignition or re-ignition.

POWERPOINT FROM ILLINOIS RENEWABLE ENERGY CONFERENCE

A PowerPoint presentation from the Illinois Renewable Energy Conference from October is also included for background.

NOT READY FOR FINAL DETERMINATION

This case is not ready for final determination.

ATTACHMENTS

A Legal Advertisement
B Revised Draft Amendment
C Excerpt of NFPA 855 pages 1 -42
D Cordelio Power BESS 101 presentation to Illinois Renewable Energy Conference October 2024

LEGAL PUBLICATION: WEDNESDAY, MARCH 13, 2024 CASE: 130-AT-24

NOTICE OF PUBLIC HEARING IN REGARD TO AN AMENDMENT TO THE TEXT OF THE CHAMPAIGN COUNTY ZONING ORDINANCE

CASE 130-AT-24

The Champaign County Zoning Administrator, 1776 East Washington Street, Urbana, has filed a petition to amend the text of the Champaign County Zoning Ordinance. The petition is on file in the office of the Champaign County Department of Planning and Zoning, 1776 East Washington Street, Urbana, IL.

A public hearing will be held **Thursday, March 28, 2024 at 6:30 p.m.** prevailing time in the Shields-Carter Meeting Room, Brookens Administrative Center, 1776 East Washington Street, Urbana, IL, at which time and place the Champaign County Zoning Board of Appeals will consider a petition for the following:

Amend the Champaign County Zoning Ordinance as follows regarding Battery Energy Storage Systems (BESS):

1. Add the following definitions to Section 3.0 Definitions: BATTERY ENERGY STORAGE MANAGEMENT SYSTEM (BESMS), BATTERY ENERGY STORAGE SYSTEM (BESS), TIER-1 BATTERY ENERGY STORAGE SYSTEMS, TIER-2 BATTERY ENERGY STORAGE SYSTEMS.

2. Add new paragraph 4.2.1 C.8. to provide that a BATTERY ENERGY STORAGE SYSTEM may be authorized as a SPECIAL USE Permit in the AG-1 and AG-2 Agriculture Districts as a second PRINCIPAL USE on a LOT with another PRINCIPAL USE.

3. Amend Section 5.2 as follows:
   a. Add “BATTERY ENERGY STORAGE SYSTEM” to be allowed by Special Use Permit in the AG-1 Agriculture, AG-2 Agriculture, B-1 Rural Trade Center, B-4 General Business, I-1 Light Industry and I-2 Heavy Industry Zoning Districts.
   b. Add Footnotes 32 and 33 regarding TIER-1 and TIER-2 requirements.

4. Add new Section 6.1.8 TIER-2 BATTERY ENERGY STORAGE SYSTEMS to establish regulations including but not limited to:
   a. General standard conditions
   b. Minimum lot standards
   c. Minimum separations
   d. Standard conditions for design and installation
   e. Standard conditions to mitigate damage to farmland
   f. Standard conditions for use of public streets
   g. Standard conditions for coordination with local fire protection district
   h. Standard conditions for allowable noise level
   i. Standard conditions for endangered species consultation
   j. Standard conditions for historic and archaeological resources review
   k. Standard conditions for acceptable wildlife impacts
   l. Screening and fencing
   m. Standard condition for liability insurance

n. Operational standard conditions
o. Standard conditions for Decommissioning and Site Reclamation Plan
p. Complaint hotline
q. Standard conditions for expiration of Special Use Permit
r. Application requirements

5. Regarding BATTERY ENERGY STORAGE SYSTEMS fees, revise Section 9 as follows:
   a. Add new paragraph 9.3.1 K. to add application fees for a BATTERY ENERGY STORAGE SYSTEMS Zoning Use Permit.

   b. Add new subparagraph 9.3.3 B.(9) to add application fees for a BATTERY ENERGY STORAGE SYSTEMS SPECIAL USE permit.

All persons interested are invited to attend said hearing and be heard. The hearing may be continued and reconvened at a later time. Meeting materials can be found online about one week before the meeting at: http://www.co.champaign.il.us/CountyBoard/meetings_ZBA.php. If you would like to submit comments or questions before the meeting, please call the P&Z Department at 217-384-3708 or email zoningdept@co.champaign.il.us no later than 4:30 pm the day of the meeting.

Ryan Elwell, Chair
Champaign County Zoning Board of Appeals

TO BE PUBLISHED: WEDNESDAY, MARCH 13, 2024, ONLY

Send bill and one copy to: Champaign County Planning and Zoning Dept.
Brookens Administrative Center
1776 E. Washington Street
Urbana, IL 61802
Phone: 384-3708

Our News Gazette account number is 99225860.

ATTACHMENT B~~EXHIBIT A:~~. PROPOSED AMENDMENT AS OF 12/12/~~MARCH 28,~~ 2024
Text added by ELUC at 1/4/24 meeting
Text added or ~~deleted~~ by P&Z Staff after ELUC meeting
New text added ~~or deleted~~ as of 12/12/2024

~~ADD AUGMENTATION~~

1. Add the following to Section 3. Definitions:

BATTERY ENERGY STORAGE MANAGEMENT SYSTEM (BESMS): An electronic system that protects battery energy storage systems from operating outside of their safe operating parameters and disconnects electrical power to the energy storage system or places it in a safe condition if potentially hazardous temperatures or other conditions are detected.

BATTERY ENERGY STORAGE SYSTEM (BESS): an electrochemical energy storage ~~power station~~ system that collects energy from the electrical grid or other electrical resource and then discharges that energy at a later time to provide electricity when needed.

A. TIER-1 BATTERY ENERGY STORAGE SYSTEMS have an aggregate energy capacity less than or equal to 600kWh and, if in a room or enclosed area, consist of only a single energy storage system technology.

B. TIER-2 BATTERY ENERGY STORAGE SYSTEMS have an aggregate energy capacity greater than 600kWh or are comprised of more than one storage battery ~~technology~~ unit in a room or enclosed area.

2. Add new paragraph 4.2.1 C.8. as follows:

4.2.1 CONSTRUCTION and USE

C. It shall be unlawful to erect or establish more than one MAIN or PRINCIPAL STRUCTURE or BUILDING per LOT or more than one PRINCIPAL USE per LOT in the AG-1, Agriculture, AG-2, Agriculture, CR, Conservation-Recreation, R-1, Single Family Residence, R-2, Single Family Residence, and R-3, Two Family Residence DISTRICTS other than in PLANNED UNIT DEVELOPMENTS except as follows:

8. A BATTERY ENERGY STORAGE SYSTEM may be authorized as a County Board SPECIAL USE Permit in the AG-1 Agriculture and AG-2 Agriculture Zoning Districts as a second PRINCIPAL USE on a LOT with another PRINCIPAL USE.”

3. Amend Section 5.2 as follows:

SECTION 5.2 TABLE OF AUTHORIZED PRINCIPAL USES

- BATTERY ENERGY STORAGE SYSTEM would be a new land use allowed by County Board Special Use Permit in the AG-1 Agriculture, AG-2 Agriculture, B-1 Rural Trade Center, B-4 General Business, I-1 Light Industry and I-2 Heavy Industry Zoning Districts, as shown in the table below.

ATTACHMENT B~~EXHIBIT A:~~. PROPOSED AMENDMENT AS OF 12/12/~~MARCH 28,~~ 2024
Text added by ELUC at 1/4/24 meeting
Text added or ~~deleted~~ by P&Z Staff after ELUC meeting
New text added ~~or deleted~~ as of 12/12/2024

Principal USES	Zoning DISTRICTS														
	CR	AG-1	AG-2	R-1	R-2	R-3	R-4	R-5	B-1	B-2	B-3	B-4	B-5	I-1	I-2
BATTERY ENERGY STORAGE SYSTEM, TIER-1[32]															
BATTERY ENERGY STORAGE SYSTEM, TIER-2[33]		SB	SB						SB			SB		SB	SB

S = Permitted on individual LOTS as a Special Use Permit

B = County Board Special Use Permit= ~~Permitted by right~~

= Permitted by right

4. Add new Footnotes 3~~2~~1 and 3~~3~~2 under Section 5.2 as follows:

3~~1~~2. A TIER-1 BATTERY ENERGY STORAGE SYSTEM is permitted by-right in all zoning districts, subject to the setback and yard requirements in Section 5.3 of the Zoning Ordinance. No Zoning Use Permit shall be required if the area occupied by the TIER-1 BESS is less than 150 square feet.

3~~2~~2. A TIER-2 BATTERY ENERGY STORAGE SYSTEM is subject to the requirements of Section 6.1.8 of the Zoning Ordinance.

5. Add new Section 6.1.8 as follows:

6.1.8 TIER-2 BATTERY ENERGY STORAGE SYSTEMS

A TIER-2 BATTERY ENERGY STORAGE SYSTEM SPECIAL USE Permit may only be authorized in the AG-1 Agriculture Zoning DISTRICT, the AG-2 Agriculture Zoning DISTRICT, B-1 Rural Trade Center, B-4 General Business, I-1 Light Industry Zoning District, or the I-2 Heavy Industry Zoning District subject to the following standard conditions.

A. General Standard Conditions

(1) Right to farm

a. The owners of the subject property and the Applicant, its successors in interest, and all parties to the decommissioning plan and site reclamation plan hereby recognize and provide for the right of agricultural activities to continue on adjacent land consistent with the Right to Farm Resolution 3425.

B. Minimum LOT Standards

(1) There are no minimum LOT AREA, AVERAGE LOT WIDTH, or maximum LOT COVERAGE requirements for a TIER-2 BATTERY ENERGY STORAGE SYSTEM.

(2) There is no maximum LOT AREA requirement on BEST PRIME FARMLAND.

C. Minimum Standard Conditions for Separations for a TIER-2 BATTERY ENERGY STORAGE SYSTEM~~S~~ from adjacent USES and STRUCTURES

The location of each TIER-2 BATTERY ENERGY STORAGE SYSTEM shall provide the following required separations as measured from the BATTERY ENERGY STORAGE SYSTEM fencing:

(1) ~~The perimeter fencing shall be at least 50 feet from the RIGHT OF WAY of any STREET.~~

The perimeter fencing shall be set back from the street centerline a minimum of 40 feet from a MINOR STREET and a minimum of 55 feet from a COLLECTOR STREET and a minimum of 60 feet from a MAJOR STREET unless a greater separation is required for screening pursuant to Section 6.1.8L.(2) but in no case shall the perimeter fencing be less than 10 feet from the RIGHT OF WAY of any STREET nor shall the TIER-2 BESS equipment be less than 55 feet from the centerline of a MINOR STREET and a minimum of 75 feet from the centerline of a COLLECTOR STREET and a minimum of 85 feet from the centerline of a MAJOR STREET. The location of perimeter fencing relative to a STREET can also be affected by the presence of a DWELLING or PRINCIPAL BUILDING per 6.1.8C.(2).

~~(1) The perimeter fencing shall be at least 50~~ 30 ~~feet from the RIGHT OF WAY of any local~~ STREET ~~or Township road or at least 45 feet from the RIGHT OF WAY of any County Highway or at least 50 feet from any State or Federal Highway.~~

(2) ~~The perimeter fencing shall be at least 200 feet from the nearest point on any property line~~ ~~with a DWELLING or other PRINCIPAL STRUCTURE or at least 10 feet from the nearest point on any property line without a DWELLING or other PRINCIPAL STRUCTURE.~~.

For properties participating in the TIER-2 BESS: More than 100 feet required separation from any existing DWELLING or existing PRINCIPAL BUILDING unless fire control and suppression are provided for the TIER-2 BESS per Section 6.1.8D.h. in which case the minimum required separation is 10 feet and otherwise, except as required to ensure that a minimum zoning LOT is provided for the existing DWELLING or PRINCIPAL BUILDING.

(3) For properties not participating in the TIER-2 BESS:

a. For any adjacent LOT that is 10 acres or less in area (not including the STREET RIGHT OF WAY):

(a) For any adjacent LOT that is bordered (directly abutting and/or across the STREET) on no more than two sides by the TIER-2 BESS, the separation shall be no less than 415 feet from the property line provided that no TIER-2 BESS

equipment is closer than 100 feet to the perimeter fence and the total required separation shall be 515 feet.

(b) For any adjacent LOT that is bordered (directly abutting and/or across the STREET) on more than two sides by the TIER-2 BESS, the separation shall exceed 415 feet as deemed necessary by the BOARD.

b. For any adjacent LOT that is more than 10 acres in area (not including the STREET RIGHT OF WAY):

(a) The minimum separation shall be no less than 430 feet from any existing DWELLING or existing PRINCIPAL BUILDING provided that no TIER-2 BESS equipment is closer than 100 feet to the perimeter fence and the total required separation shall be 530 feet.

(b) Provided that no TIER-2 BESS equipment is closer than 530 feet to any existing DWELLING or existing PRINCIPAL BUILDING, the perimeter fencing shall otherwise be a minimum of 10 feet from a SIDE or REAR LOT LINE. This separation distance applies to properties that are adjacent to or across a STREET from a TIER-2 BESS.

c. Additional separation may be required to ensure that the noise level required by 35 Ill. Admin. Code Parts 900, 901 and 910 is not exceeded or for other purposes deemed necessary by the BOARD

~~The separation of the perimeter fencing from the nearest point on the property line shall be as follows for properties not participating in the TIER-2 BESS:~~

~~a. For any adjacent LOT that is 10 acres or less in area (not including the STREET RIGHT OF WAY):~~

~~(a) For any adjacent LOT that is bordered (directly abutting and/or across the STREET) on no more than two sides by the TIER-2 BESS, the separation shall be no less than 240 feet from the property line.~~

~~(b) For any adjacent LOT that is bordered (directly abutting and/or across the STREET) on more than two sides by the TIER-2 BESS, the separation shall exceed 240 feet as deemed necessary by the BOARD.~~

~~b. For any adjacent LOT that is more than 10 acres in area (not including the STREET RIGHT OF WAY), the separation shall be no less than 240 feet from the property line if there is an existing DWELLING within 515 feet of the property line or an existing PRINCIPAL BUILDING within 515 feet from the property line but if there is no DWELLING within 515 feet from the property line or existing PRINCIPAL BUILDING within 515 feet from the property line, the perimeter fencing shall be a minimum of 10 feet from a SIDE or REAR LOT LINE. This separation distance applies to properties that are adjacent to or across a STREET from a TIER-2 BESS.~~

~~c. Additional separation may be required to ensure that the noise level required by 35 Ill. Admin. Code Parts 900, 901 and 910 is not exceeded or for other purposes deemed necessary by the BOARD.~~

~~(3) For properties participating in the TIER-2 BESS, the minimum required separation from any existing DWELLING or existing PRINCIPAL BUILDING to the TIER-2 BESS is more than 100 feet unless fire control and suppression are provided per Section 6.1.8D.h. in which case the minimum required separation is 10 feet and except as required to ensure that a minimum zoning LOT is provided for the existing DWELLING or PRINCIPAL BUILDING.~~

~~(4~~3~~) There shall be at least 500 feet of separation from any existing DWELLING or existing PRINCIPAL BUILDING. This separation may be reduced to no less than 200 feet upon submission of a PRIVATE WAIVER signed by the owner of said DWELLING or PRINCIPAL BUILDING.~~

~~(4~~5~~) Additional separation may be required to ensure that the noise level required by *35 Ill. Admin. Code Parts 900, 901 and 910* is not exceeded or for other purposes deemed necessary by the BOARD.~~

(~~5~~6) When a TIER-2 BATTERY ENERGY STORAGE SYSTEM is included in a PV SOLAR FARM or a SOLAR ARRAY or a WIND FARM, the separations required in Sections 6.1.8C. (2) and (3) shall only apply to the TIER-2 BATTERY ENERGY STORAGE SYSTEM, except for the interconnection point and driveway for the TIER-2 BATTERY ENERGY STORAGE SYSTEM, and shall not apply to any part of the PV SOLAR FARM or a SOLAR ARRAY or a WIND FARM.

D. Standard Conditions for Design and Installation of any TIER-2 BATTERY ENERGY STORAGE SYSTEM.

(1) Any building that is part of a TIER-2 BATTERY ENERGY STORAGE SYSTEM shall include as a requirement for a Zoning Compliance Certificate, a certification by an Illinois Professional Engineer or Illinois Licensed Structural Engineer or other qualified professional that the constructed building conforms to Public Act 101-369 regarding building code compliance and conforms to the Illinois Accessibility Code.

(2) Electrical Components

a. All electrical components of the TIER-2 BATTERY ENERGY STORAGE SYSTEM shall conform to the National Electrical Code as amended.

b. All on-site utility lines shall be placed underground to the extent feasible and as permitted by the serving utility, with the exception of the main service connection at the utility company right-of-way and any new interconnection equipment, including without limitation any poles, with new easements and right-of-way. Source: NY BESS Guidebook for Local Governments

(3) Maximum Height. The height limitation established in Section 5.3 shall not apply to a TIER-2 BATTERY ENERGY STORAGE SYSTEM. The maximum height of all above ground STRUCTURES shall be identified in the application and as approved in the SPECIAL USE Permit.

(4) Warnings

a. A reasonably visible warning sign shall be installed and shall include the type of technology associated with the battery energy storage systems, any special hazards associated, the type of suppression system installed in the area of battery energy storage systems, and 24-hour emergency contact information, including reach-back phone number. Source: NY BESS Guidebook for Local Governments

b. As required by the National Electric Code (NEC), disconnect and other emergency shutoff information shall be clearly displayed on a light reflective surface. A clearly visible warning sign concerning voltage shall be placed at the base of all pad-mounted transformers and substations. Source: NY BESS Guidebook for Local Governments

(5) No construction may intrude on any easement or right-of-way for a GAS PIPELINE or HAZARDOUS LIQUID PIPELINE, an underground water main or sanitary sewer, a drainage district ditch or tile, or any other public utility facility unless specifically authorized by a crossing agreement that has been entered into with the relevant party.

(6) Safety

a. ~~System Certification~~ Standards. Battery energy storage systems and equipment shall be listed by a Nationally Recognized Testing Laboratory to UL 9540 (Standard for battery energy storage systems and Equipment) and UL 9540A (Standard for Testing Methods for

Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems) with subcomponents meeting each of the following standards as applicable:

(a) ~~(a)~~ IEEE 1578 (Institute of Electrical and Electronics Engineers; Recommended Practice for Stationary Battery Electrolyte Spill Containment and Management~~)~~; only required for installations using lead-acid batteries);

(b) NFPA 13 (Standard for Installation of Sprinkler Systems);

(c) NFPA 68 (Standard on Explosion Prevention by Deflagration Venting);

(d) NFPA 69 (Standard on Explosion Prevention Systems);

(e) NFPA 855 (Standard for the Installation of Stationary Energy Storage Systems)

(f) NFPA 1142 (Standard on Water Supplies for Suburban and Rural Firefighting);

(g) NFPA 2010 (Standard for Fixed Aerosol Fire Extinguishing Systems);

(h~~f~~) UL 1973 (Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail Applications);

(i~~g~~) UL 1642 (Standard for Lithium Batteries);

(j~~h~~) UL 1741 or UL 62109 (Inverters and Power Converters);

~~(i) Certified under the applicable electrical, building, and fire prevention codes as required;~~

(j) Alternatively, field evaluation by an approved testing laboratory for compliance with UL 9540 and applicable codes, regulations and safety standards may be used to meet system certification requirements.

b. Hazard Mitigation Analysis

(a) The Special Use Permit Application shall include a commitment to the provision of a Hazard Mitigation Analysis that will comply with the requirements of NFPA 855 and an approved Special Use Permit shall include a special condition of approval requiring compliance with NFPA 855 requirements for a Hazard Mitigation Analysis.

(b) Prior to application for a Zoning Use Permit, the TIER-2 BESS Owner shall provide to the relevant fire protection district or department a Hazard Mitigation Analysis of the proposed BESS that meets the requirements of NFPA 855.

(c) The relevant fire protection district or department shall document their approval of the Hazard Mitigation Analysis in writing if the Hazard Mitigation Analysis meets the requirements for approval in Section 4.4.3 of NFPA 855.

(d) The Zoning Use Permit Application for the proposed TIER-2 BESS shall include documentation that the relevant fire protection district or department has approved the Hazard Mitigation Analysis and a copy of the approved Hazard Mitigation Analysis shall be submitted with the Zoning Use Permit Application.

c. Commissioning Report

(a) Prior to requesting a Zoning Compliance Certificate to authorize operation of the TIER-2 BESS, the TIER-2 BESS Owner shall provide to the relevant fire protection district or department a Commissioning Report that meets the requirements of NFPA 855.

(b) A Zoning Compliance Certificate for a TIER-2 BESS shall not be issued unless the Zoning Administrator receives written documentation that the relevant fire protection district or department has received the Commissioning Report and a copy of the Commissioning Report shall be submitted to the Zoning Administrator.

d. Vegetation control.

(a) Areas within 10 feet on each side of outdoor TIER-2 BESS equipment shall be cleared of combustible vegetation except that grass may be used as a ground cover provided it is

maintained such that it does not form a means of readily transmitting fire.

e. Access drives.

(a) For TIER-2 BESS that are located outdoors, no part of the TIER-2 BESS shall be located more than 100 feet from an access drive that is a minimum of 20 feet wide and made of eight inches of compacted aggregate and with corner radii that meets the requirements of the relevant fire protection district or department.

~~b~~f. BATTERY ENERGY STORAGE MANAGEMENT SYSTEM

(a) When thermal runaway protection is required by NFPA 855 for the type of TIER-2 BESS that is proposed, the TIER-2 BESS shall include a BATTERY ENERGY STORAGE MANAGEMENT SYSTEM to protect the energy storage systems from operating outside of the safe operating parameters and that will disconnect electrical power to the energy storage system or place it in a safe condition if potentially hazardous temperatures or other conditions are detected and prevent thermal runaway.

(b) Both the Special Use Permit Application and the Zoning Use Permit Application shall include a basic description of the proposed BATTERY ENERGY STORAGE MANAGEMENT SYSTEM. ~~by an Illinois Licensed Professional Engineer.~~

~~e~~g. ~~Hazard~~ Smoke and fire detection systems.

~~(a) A TIER-2 BESS shall include appropriate hazard detection systems including smoke and heat detectors and gas meters that are monitored by a control center and used to alert operators to emergency situations.~~

~~(b) The application shall include a description of the hazard detection systems and the control center by an Illinois Licensed Professional Engineer.~~

(a) Smoke and fire detection systems shall not be required for TIER-2 BESS that are installed outdoors (not on or inside a building or in a walk-in unit no larger than 53 feet by 8.5 feet

by 9.5 feet) unless smoke and fire detection systems are recommended to the BOARD in writing by the relevant fire protection district or department or unless the BOARD requires smoke and fire detection systems as a special condition of approval.

(b) Smoke and fire detection systems shall be required for TIER-2 BESS that are installed on or inside a building or in a walk-in unit larger than 53 feet by 8.5 feet by 9.5 feet.

(c) When smoke and fire detection systems are required by NFPA 855 for the type of TIER-2 BESS that is proposed, the following descriptions shall be provided at relevant times in the zoning approval process:

i. The Special Use Permit Application shall include a basic description of the proposed smoke and fire detection systems.

ii. The Zoning Use Permit Application shall include a description of the proposed smoke and fire detection systems.by an Illinois Licensed Professional Engineer including both text and drawings.

~~d~~h. Fire control and suppression

~~(a) Safe access to the TIER-2 BESS by the relevant Fire Protection Department District shall be considered in the site plan design.~~

~~(b) In-rack fire suppression shall be included.~~

~~(c) If the TIER-2 BESS is installed in a BUILDING (not including an intermodal storage container), the BUILDING shall have sprinklers should be installed per NFPA 13 but in-rack fire suppression shall also be included. An onsite water source shall be provided that is acceptable to the relevant Fire Protection Department if the BESS is not located within 300 feet of a fire hydrant on a connected PUBLIC WATER SUPPLY SYSTEM. The sizing of the water source shall be specified in the application by an Illinois Licensed Professional Engineer.~~

~~(c) Containment around the TIER-2 BESS STRUCTURE shall be provided to capture sprinkler system run-off. The sizing of the containment area shall be specified in the application~~

~~by an Illinois Licensed Professional Engineer and the containment area shall be detailed on the site plan.~~

~~(d) Gaseous suppression agents may be used against incipient fires but shall not be the only suppression agent.~~

(a) Fire control and suppression systems and water supply for fire fighting shall not be required for TIER-2 BESS that are installed outdoors (not on or inside a building or in a walk-in unit no larger than 53 feet by 8.5 feet by 9.5 feet) and located more than 100 feet from other buildings, lot lines, public ways, stored combustible materials, hazardous materials , high-piled stock, and other exposure hazards not associated with electrical grid infrastructure unless fire suppression systems and water supply are recommended to the BOARD in writing by the relevant fire protection district or department or unless the BOARD requires fire suppression systems and/ or water supply as a special condition of approval.

(b) Fire control and suppression systems and water supply for fire fighting shall be required for TIER-2 BESS that are installed outdoors (not located on or inside a building or in a walk-in unit larger than 53 feet by 8.5 feet by 9.5 feet) and located less than 100 feet from other buildings, lot lines, public ways, stored combustible materials, hazardous materials , high-piled stock, and other exposure hazards not associated with electrical grid infrastructure or located on or inside a building or a walk-in unit that is larger than 53 feet by 8.5 feet by 9.5 feet).

(c) When fire control and suppression systems and water supply for fire fighting are required by NFPA 855 for the type of TIER-2 BESS that is proposed, the following descriptions shall be provided at relevant times in the zoning approval process:

i. The Special Use Permit Application shall include a basic description of the proposed fire control and suppression systems and water supply.

ii. The Zoning Use Permit Application shall include a description of the proposed fire control and suppression systems and water supply, by an Illinois Licensed Professional Engineer including both text and drawings.

(d) The relevant fire protection district or department shall be the authority having jurisdiction per NFPA 855 for approving TIER-2 BESS to be installed in open parking garages and/or dedicated-use BESS buildings and/or outdoor walk-in enclosures without the protection of automatic fire control and suppression systems where authorized by NFPA 855 and such approvals shall be documented in writing and a copy of the approval shall be submitted with the Zoning Use Permit Application.

i. Explosion control.

(a) Explosion prevention or deflagration venting shall be provided that will comply with the requirements of NFPA 855 for the type of TIER-2 BESS that is proposed.

(b) The Special Use Permit Application shall include a commitment to the provision of explosion prevention and/ or deflagration venting that will comply with the requirements of NFPA 855 and an approved Special Use Permit shall include a special condition of approval requiring compliance with NFPA 855 requirements for explosion prevention and/ or deflagration venting.

(c) The actual description of the explosion prevention or deflagration venting to be provided shall be part of the Hazard Mitigation Analysis required by Sec. 6.1.8D.(6)b.

~~b. BATTERY ENERGY STORAGE MANAGEMENT SYSTEM.~~

~~(a) A TIER-2 BESS shall include a BATTERY ENERGY STORAGE MANAGEMENT SYSTEM to protect the energy storage systems from operating outside of the safe operating parameters and that will disconnect electrical power to the energy storage system or place it in a safe condition if potentially hazardous temperatures or other conditions are detected.~~

~~(b) The application shall include a description of the proposed BATTERY ENERGY STORAGE MANAGEMENT SYSTEM by an Illinois Licensed Professional Engineer.~~

~~c. Hazard detection systems.~~

~~(a) A TIER-2 BESS shall include appropriate hazard detection systems including smoke and heat detectors and gas meters that are monitored by a control center and used to alert operators to emergency situations.~~

~~(b) The application shall include a description of the hazard detection systems and the control center by an Illinois Licensed Professional Engineer.~~

~~d. Fire suppression~~

~~(a) Safe access to the TIER-2 BESS by the relevant Fire Protection Department shall be considered in the site plan design.~~

~~(b) Sprinklers should be installed per NFPA 13 but in-rack fire suppression shall also be included. An onsite water source shall be provided that is acceptable to the relevant Fire Protection Department. The sizing of the water source shall be specified in the application by an Illinois Licensed Professional Engineer.~~

~~(c) Containment around the TIE-2 BESS structure shall be provided to capture sprinkler system run-off. The sizing of the containment area shall be specified in the application by an Illinois Licensed Professional Engineer and the containment area shall be detailed on the site plan.~~

~~(d) Gaseous suppression agents may be used against incipient fires but shall not be the only suppression agent.~~

~~e~~ j. Ground-fault protection

(a) Three-phase installations shall have adequate ground-fault protection ~~and the application shall include a discussion of the adequacy of the proposed ground fault protection by an Illinois Licensed Professional Engineer~~.

(b) Systems with little or no impedance shall be designed to trip off-line automatically.

(c) In systems that have high levels of impedance the overvoltage shall be controlled with grounding banks, other forms of impedance grounding, or surge arresters. The electrical components at risk of overvoltage shall also have phase-to-phase level insulation.

(d) The Zoning Use Permit ~~a~~Application shall include a description of the ground-fault protection by an Illinois Licensed Professional Engineer.

~~f~~ k. Control of electrolyte spill.

(a) When spill control is required by NFPA 855 for the type of TIER-2 BESS that is proposed, the Special Use Permit Application shall include a general description and written discussion for the proposed control of electrolyte spill that will meet NFPA 855 requirements.

(b) The Zoning Use Permit Application shall include a description of the proposed spill control by an Illinois Licensed Professional Engineer .

l. Neutralization of spills from free-flowing electrolyte.

(a) When neutralization of free-flowing electrolyte is required by NFPA 855 for the type of TIER-2 BESS that is proposed, the Special Use Permit Application shall include a written discussion of the proposed neutralization that meets the requirements of NFPA 855.

(b) The Zoning Use Permit Application shall include a written discussion of the proposed neutralization by an Illinois Licensed Professional Engineer that meets the requirements of NFPA 855.

m. Safety caps. When safety caps are required by NFPA 855 for the type of TIER-2 BESS that is proposed, both the Special Use Permit Application and the Zoning Use Permit Application shall include a description of the proposed safety caps that meets the requirements of NFPA 855.

~~g~~ n. Exhaust ventilation.

~~(a) For TIER-2 BESS that is located inside a habitable building, the ventilation of the TIER-2 BESS should take the building ventilation systems into account to prevent any hazardous gases from being drawn into habitable rooms and putting building occupants at risk.~~

~~(b) The application shall include a narrative written by an Illinois Licensed Professional Engineer addressing gas production in the TIER-2 BESS under thermal runaway conditions and the safeguards included to control and/or respond to gas production. The safeguards shall include a series of safeguards including fire suppression, ventilation, and explosion mitigation.~~

(a) When exhaust ventilation is required by NFPA 855 for the type of TIER-2 BESS that is proposed, the following descriptions shall be provided at relevant milestones:
i. The Special Use Permit Application shall include a basic description of the proposed exhaust ventilation.
ii. The Zoning Use Permit Application shall include a description of the proposed exhaust ventilation.by an Illinois Licensed Professional Engineer including both text and drawings.

o. TIER-2 BESS in or on buildings.

(a) When a TIER-2 BESS is proposed to be located in or on a building or in a walk-in unit larger than 53 feet by 8.5 feet by 9.5 feet, compliance with all relevant NFPA 855 requirements shall be explained in general in the Special Use Permit Application with more detailed description submitted at the time of Zoning Use Permit Application including text and drawings by an Illinois Licensed Architect and/or an Illinois Licensed Professional Engineer.

p. Remediation measures.

(a) As required by NFPA 855, in the event that a fire or other event has damaged the TIER-2 BESS and ignition or reignition of the TIER-2 BESS is possible, the owner of the TIER-2 BESS shall provide authorized service personnel to be dispatched to assist emergency first responders to mitigate the hazard or remove damaged equipment from the premises within a response time approved by the relevant fire protection district or department in the approved emergency response plan.

(b) When required by the relevant fire protection district or department, the owner of the TIER-2 BESS shall provide hazard support personnel at the expense of the owner of the

TIER-2 BESS to respond to possible ignition or re-ignition of the damaged TIER-2 BESS within a response time approved by the relevant fire protection district or department in the approved emergency response plan, as required by NFPA 855.

(c) The trained hazard support personnel shall be approved by the relevant fire protection district or department.

(d) The authorized service personnel shall be permitted to perform the duties of the hazard support personnel.

(e) Required hazard support personnel shall monitor the TIER-2 BESS continuously in a method approved by the relevant fire protection district or department until the hazard is mitigated and the relevant fire protection district or department gives authorization to the owner or authorized agent that onsite hazard support personnel are no longer required.

(f) On-duty hazard support personnel shall have the responsibilities listed in NFPA 855.

(g) The Special Use Permit application shall include a commitment to the provision of authorized service personnel and/or hazard support personnel that will comply with the requirements of NFPA 855 and an approved Special Use Permit shall include a special condition of approval requiring compliance with NFPA 855 requirements for the provision of authorized service personnel and/or hazard support personnel.

~~f. Control of electrolyte spill. The application shall include a discussion by an Illinois Licensed Professional Engineer regarding possible electrolyte spill and the adequacy of the proposed control of electrolytes in the event of a spill.~~

~~g. Ventilation~~

~~(a) For TIER-2 BESS that is located inside a habitable building, the ventilation of the TIER-2 BESS should take the building ventilation systems into account to prevent any hazardous gases from being drawn into habitable rooms and putting building occupants at risk.~~

~~(b) The application shall include a narrative written by an Illinois Licensed Professional Engineer addressing gas production in the TIER-2 BESS under thermal runaway conditions and the safeguards included to control and/or respond to gas production. The safeguards shall include a series of safeguards including fire suppression, ventilation, and explosion mitigation.~~

(7) Cooling of a TIER-2 BESS shall not use groundwater other than for closed-loop geothermal cooling. The application shall include a description of the proposed cooling system of the TIER-2 BESS.

E. Standard Conditions to Mitigate Damage to Farmland

(1) All underground wiring or cabling for the TIER-2 BATTERY ENERGY STORAGE SYSTEM shall be at a minimum depth of 5 feet below grade or deeper if required to maintain a minimum one foot of clearance between the wire or cable and any agricultural drainage tile.

(2) Protection of agricultural drainage tile

a. The applicant shall endeavor to locate all existing agricultural drainage tile prior to establishing any construction staging areas, construction of any necessary TIER-2 BATTERY ENERGY STORAGE SYSTEM access lanes or driveways, construction of any TIER-2 BATTERY ENERGY STORAGE SYSTEM STRUCTURES, any equipment, underground wiring, or cabling. The applicant shall contact affected landowners and tenants and the Champaign County Soil and Water Conservation District and any relevant drainage district for their knowledge of tile line locations prior to the proposed construction. Drainage districts shall be notified at least two weeks prior to disruption of tile.

b. The location of drainage district tile lines shall be identified prior to any construction and drainage district tile lines shall be protected from disturbance as follows:

(a) All identified drainage district tile lines and any known existing drainage district tile easement shall be staked or flagged prior to construction to alert construction crews of the presence of drainage district tile and the related easement.

(b) Any drainage district tile for which there is no existing easement shall be protected from disturbance by a 30 feet wide no-construction buffer on either side of the drainage district tile. The no-construction buffer shall be staked or flagged prior to the start of construction and shall remain valid for the lifetime of the TIER-2 BATTERY ENERGY STORAGE SYSTEM SPECIAL USE Permit and during any deconstruction activities that may occur pursuant to the TIER-2 BATTERY ENERGY STORAGE SYSTEM SPECIAL USE Permit.

(c) Construction shall be prohibited within any existing drainage district easement and also prohibited within any 30 feet wide no-construction buffer on either side of drainage district tile that does not have an existing easement unless specific construction is authorized in writing by all commissioners of the relevant drainage district. A copy of the written authorization shall be provided to the Zoning Administrator prior to the commencement of construction.

c. Any agricultural drainage tile located underneath construction staging areas, access lanes, and driveways shall be replaced as required in Section 6.3 of the Champaign County Storm Water Management and Erosion Control Ordinance.

d. Any agricultural drainage tile that must be relocated shall be relocated as required in the *Champaign County Storm Water Management and Erosion Control Ordinance*.

e. Conformance of any relocation of drainage district tile with the *Champaign County Storm Water Management and Erosion Control Ordinance* shall be certified by an Illinois Professional Engineer. Written approval by the drainage district shall be received prior to any backfilling of the relocated drain tile and a copy of the approval shall be submitted to the Zoning Administrator. As-built drawings shall be provided to both the relevant drainage district and the Zoning Administrator of any relocated drainage district tile.

f. All tile lines that are damaged, cut, or removed shall be staked or flagged in such manner that they will remain visible until the permanent repairs are completed.

g. All exposed tile lines shall be screened or otherwise protected to prevent the entry into the tile of foreign materials, loose soil, small mammals, etc.

h. Permanent tile repairs shall be made within 14 days of the tile damage provided that weather and soil conditions are suitable or a temporary tile repair shall be made. Immediate temporary repair shall also be required if water is flowing through any damaged tile line. Temporary repairs are not needed if the tile lines are dry and water is not flowing in the tile provided the permanent repairs can be made within 14 days of the damage.

i. All damaged tile shall be repaired so as to operate as well after construction as before the construction began.

j. Following completion of the TIER-2 BATTERY ENERGY STORAGE SYSTEM construction, the A~~a~~pplicant shall be responsible for correcting all tile line repairs that fail, provided that the failed repair was made by the Applicant.

(3) All soil conservation practices (such as terraces, grassed waterways, etc.) that are damaged by TIER-2 BATTERY ENERGY STORAGE SYSTEM construction, maintenance, and/or decommissioning shall be restored by the applicant to the pre- TIER-2 BATTERY ENERGY STORAGE SYSTEM construction condition.

(4) Topsoil replacement

For any open trenching required pursuant to TIER-2 BATTERY ENERGY STORAGE SYSTEM construction, the topsoil shall be stripped and replaced as follows:

a. The top 12 inches of topsoil shall first be stripped from the area to be trenched and from an adjacent area to be used for subsoil storage. The topsoil shall be stored in a windrow parallel to the trench in such a manner that that it will not become intermixed with subsoil materials.

b. All subsoil material that is removed from the trench shall be placed in the second adjacent stripped windrow parallel to the trench but separate from the topsoil windrow.

c. In backfilling the trench, the stockpiled subsoil material shall be placed back into the trench before replacing the topsoil.

d. The topsoil must be replaced such that after settling occurs, the topsoil's original depth and contour (with an allowance for settling) will be restored.

(5) Mitigation of soil compacting and rutting

a. The Applicant shall not be responsible for mitigation of soil compaction and rutting if exempted by the TIER-2 BATTERY ENERGY STORAGE SYSTEM lease.

b. Unless specifically provided for otherwise in the TIER-2 BATTERY ENERGY STORAGE SYSTEM lease, the Applicant

shall mitigate soil compaction and rutting for all areas of farmland that were traversed with vehicles and construction equipment or where topsoil is replaced in open trenches.

(6) Land leveling

a. The Applicant shall not be responsible for leveling of disturbed land if exempted by the TIER-2 BATTERY ENERGY STORAGE SYSTEM lease.

b. Unless specifically provided for otherwise in the TIER-2 BATTERY ENERGY STORAGE SYSTEM lease, the Applicant shall level all disturbed land as follows:

(a) Following the completion of any open trenching, the applicant shall restore all land to its original pre-construction elevation and contour.

(b) Should uneven settling occur or surface drainage problems develop as a result of the trenching within the first year after completion, the applicant shall again restore the land to its original pre-construction elevation and contour.

(7) Permanent Erosion and Sedimentation Control Plan

a. Prior to the approval of any Zoning Use Permit, the Applicant shall provide a permanent soil erosion and sedimentation plan for the TIER-2 BATTERY ENERGY STORAGE SYSTEM including any access road that conforms to the relevant Natural Resources Conservation Service guidelines and that is prepared by an Illinois Licensed Professional Engineer.

b. As-built documentation of all permanent soil erosion and sedimentation improvements for the TIER-2 BATTERY ENERGY STORAGE SYSTEM including any access road prepared by an Illinois Licensed Professional Engineer shall be submitted and accepted by the Zoning Administrator prior to approval of any Zoning Compliance Certificate.

(8) Retention of all topsoil

No topsoil may be removed, stripped, or sold from the proposed SPECIAL USE Permit site pursuant to or as part of the construction of the TIER-2 BATTERY ENERGY STORAGE SYSTEM.

(9) Minimize disturbance to BEST PRIME FARMLAND

a. Any TIER-2 BATTERY ENERGY STORAGE SYSTEM to be located on BEST PRIME FARMLAND shall minimize the disturbance to BEST PRIME FARMLAND as follows:

(a) The disturbance to BEST PRIME FARMLAND caused by construction and operation of the TIER-2 BATTERY ENERGY STORAGE SYSTEM shall be minimized at all times consistent with good engineering practice.

F. Standard Conditions for Use of Public Streets

Any TIER-2 BATTERY ENERGY STORAGE SYSTEM applicant proposing to use any County Highway or a township or municipal STREET for the purpose of transporting TIER-2 BATTERY ENERGY STORAGE SYSTEM equipment for construction, operation, or maintenance of the TIER-2 BATTERY ENERGY STORAGE SYSTEM shall identify all such public STREETS and pay the costs of any necessary permits and the costs to repair any damage to the STREETS caused by the TIER-2 BATTERY ENERGY STORAGE SYSTEM construction, as follows:

(1) Prior to the close of the public hearing before the BOARD, the Applicant shall enter into a Roadway Upgrade and Maintenance agreement approved by the County Engineer and State's Attorney; or Township Highway Commissioner; or municipality where relevant, except for any TIER-2 BATTERY ENERGY STORAGE SYSTEM for which the relevant highway authority has agreed in writing to waive the requirements of subparagraphs 6.1.8 F.1, 6.1.8 F.2, and 6.1.8 F.3, and the signed and executed Roadway Upgrade and Maintenance agreements must provide for the following minimum conditions:

a. The applicant shall agree to conduct a pre- TIER-2 BATTERY ENERGY STORAGE SYSTEM construction baseline survey to determine existing STREET conditions for assessing potential future damage including the following:

(a) A videotape of the affected length of each subject STREET supplemented by photographs if necessary.

(b) Pay for costs of the County to hire a consultant to make a study of any structure on the proposed route that the County Engineer feels may not carry the loads likely during the TIER-2 BATTERY ENERGY STORAGE SYSTEM construction.

(c) Pay for any strengthening of STREET structures that may be necessary to accommodate the proposed traffic loads caused by the ~~PV SOLAR FARM~~BATTERY ENERGY STORAGE SYSTEM construction.

b. The Applicant shall agree to pay for costs of the County Engineer to hire a consultant to make a study of any structure on the proposed route that the County Engineer feels may not carry the loads likely during the TIER-2 BATTERY ENERGY STORAGE SYSTEM construction and pay for any strengthening of structures that may be necessary to accommodate the proposed traffic loads caused by the TIER-2 BATTERY ENERGY STORAGE SYSTEM construction.

c. The Applicant shall agree upon an estimate of costs for any other necessary roadway improvements prior to construction.

d. The Applicant shall obtain any necessary approvals for the STREET improvements from the relevant STREET maintenance authority.

e. The Applicant shall obtain any necessary Access Permits including any required plans.

f. The Applicant shall erect permanent markers indicating the presence of underground cables.

g. The Applicant shall install marker tape in any cable trench.

h. The Applicant shall become a member of the Illinois statewide One-Call Notice System (otherwise known as the Joint Utility Locating Information for Excavators or "JULIE") and provide JULIE with all of the information necessary to update its record with respect to the TIER-2 BATTERY ENERGY STORAGE SYSTEM.

i. The Applicant shall use directional boring equipment to make all crossings of County Highways for the cable collection system.

j. The Applicant shall notify the STREET maintenance authority in advance of all oversize moves and crane crossings.

k. The Applicant shall provide the County Engineer with a copy of each overweight and oversize permit issued by the Illinois Department of Transportation for the TIER-2 BATTERY ENERGY STORAGE SYSTEM construction.

l. The Applicant shall transport the TIER-2 BATTERY ENERGY STORAGE SYSTEM loads so as to minimize adverse impact on the local traffic including farm traffic.

m. The Applicant shall schedule TIER-2 BATTERY ENERGY STORAGE SYSTEM construction traffic in a way to minimize adverse impacts on emergency response vehicles, rural mail delivery, school bus traffic, and local agricultural traffic.

n. The Applicant shall provide as much advance notice as in commercially reasonable to obtain approval of the STREET maintenance authority when it is necessary for a STREET to be closed due to a crane crossing or for any other reason. Notwithstanding the generality of the aforementioned, the Applicant will provide 48 hours' notice to the extent reasonably practicable.

o. The Applicant shall provide signs indicating all highway and STREET closures and work zones in accordance with the Illinois Department of Transportation Manual on Uniform Traffic Control Devices.

p. The Applicant shall establish a single escrow account and a single Irrevocable Letter of Credit for the cost of all STREET upgrades and repairs pursuant to the TIER-2 BATTERY ENERGY STORAGE SYSTEM construction.

q. The Applicant shall notify all relevant parties of any temporary STREET closures.

r. The Applicant shall obtain easements and other land rights needed to fulfill the Applicant's obligations under this Agreement.

s. The Applicant shall agree that the County shall design all STREET upgrades in accordance with the most recent edition of the IDOT Bureau of Local Roads and Streets Manual.

t. The Applicant shall provide written Notice to Proceed to the relevant STREET maintenance authority by December 31 of each year that identifies the STREETS to be upgraded during the following year.

u. The Applicant shall provide dust control and grading work to the reasonable satisfaction of the County Engineer on STREETS that become aggregate surface STREETS.

v. The Applicant shall conduct a post- TIER-2 BATTERY ENERGY STORAGE SYSTEM construction baseline survey similar to the pre- TIER-2 BATTERY ENERGY STORAGE SYSTEM construction baseline survey to identify the extent of repairs necessary to return the STREETS to the pre- TIER-2 BATTERY ENERGY STORAGE SYSTEM construction condition.

w. The Applicant shall pay for the cost of all repairs to all STREETS that are damaged by the Applicant during the construction of the TIER-2 BATTERY ENERGY STORAGE SYSTEM and restore such STREETS to the condition they were in at the time of the pre-TIER-2 BATTERY ENERGY STORAGE SYSTEM construction inventory.

x. All TIER-2 BATTERY ENERGY STORAGE SYSTEM construction traffic shall exclusively use routes designated in the approved Transportation Impact Analysis.

y. The Applicant shall provide liability insurance in an acceptable amount to cover the required STREET construction activities.

z. The Applicant shall pay for the present worth costs of life consumed by the construction traffic as determined by the pavement management surveys and reports on the roads which do not show significant enough deterioration to warrant immediate restoration.

aa. Provisions for expiration date on the agreement.

bb. Other conditions that may be required.

(2) A condition of the County Board SPECIAL USE Permit approval shall be that the Zoning Administrator shall not authorize a Zoning Use Permit for the TIER-2 BATTERY ENERGY STORAGE SYSTEM until the County Engineer and State's Attorney, or Township Highway Commissioner, or municipality where relevant, has approved a Transportation Impact Analysis provided by the Applicant and prepared by an independent engineer that is mutually acceptable to the Applicant and the County Engineer and State's Attorney, or Township Highway Commissioner, or municipality where relevant, that includes the following:

a. Identify all such public STREETS or portions thereof that are intended to be used by the Applicant during construction of the TIER-2 BATTERY ENERGY STORAGE SYSTEM as well as the number of loads, per axle weight of each load, and type of equipment that will be used to transport each load.

b. A schedule of the across road culverts and bridges affected by the project and the recommendations as to actions, if any, required with respect to such culverts and bridges and estimates of the cost to replace such culverts and bridges.

c. A schedule of the anticipated STREET repair costs to be made in advance of the TIER-2 BATTERY ENERGY STORAGE SYSTEM construction and following construction of the TIER-2 BATTERY ENERGY STORAGE SYSTEM.

d. The Applicant shall reimburse the County Engineer, or Township Highway Commissioner, or municipality where relevant, for all reasonable engineering fees including the cost of a third-party consultant, incurred in connection with the review and approval of the Transportation Impact Analysis.

(3) At such time as decommissioning takes place, the Applicant or its successors in interest shall enter into a Roadway Use and Repair Agreement with the appropriate highway authority.

G. Standard Conditions for Coordination with Local Fire Protection District

(1) The Applicant shall submit to the local fire protection district a copy of the site plan.

(2) The Owner or Operator shall cooperate with the local fire protection district to develop the fire protection district's emergency response plan. The emergency response plan shall include the following information:

a. Procedures for safe shutdown, de-energizing, or isolation of equipment and systems under emergency conditions to reduce the risk of fire, electric shock, and personal injuries, and for safe start-up following cessation of emergency conditions.

b. Procedures for inspection and testing of associated alarms, interlocks, and controls.

c. Procedures to be followed in response to notifications from the TIER-2 BATTERY ENERGY STORAGE MANAGEMENT SYSTEM, when provided, that could signify potentially dangerous conditions, including shutting down equipment, summoning service and repair personnel, and providing agreed upon notification to fire department personnel for potentially hazardous conditions in the event of a system failure.

d. Emergency procedures to be followed in case of fire, explosion, release of liquids or vapors, damage to critical moving parts, or other potentially dangerous conditions. Procedures can include sounding the alarm, notifying the fire department, evacuating personnel, de-energizing equipment, and controlling and extinguishing the fire.

e. Response considerations similar to a safety data sheet (SDS) that will address response safety concerns and extinguishment when an SDS is not required.

f. Procedures for dealing with TIER-2 BATTERY ENERGY STORAGE SYSTEM equipment damaged in a fire or other emergency event, including maintaining contact information for personnel qualified to safely remove damaged TIER-2 BATTERY ENERGY STORAGE SYSTEM equipment from the facility.

g. Other procedures as determined necessary by the relevant Fire Protection District to provide for the safety of occupants, neighboring properties, and emergency responders.

h. Procedures and schedules for conducting drills of these procedures and for training local first responders on the contents of the plan and appropriate response procedures.

Source: NFPA 855 and NY BESS Guidebook for Local Governments

i. An explanation of the arrangements for the TIER-2 BESS owner to provide authorized service personnel and/ or hazard support personnel to assist first responders to mitigate the hazard or remove damaged equipment from the premises within an acceptable response time.

(3) Documentation that the relevant fire protection district or department has accepted the emergency response plan shall be submitted with the Zoning Use Permit Application.

(~~3~~ 4) Nothing in this section shall alleviate the need to comply with all other applicable fire laws and regulations.

H. Standard Conditions for Allowable Noise Level

(1) Noise levels from any TIER-2 BATTERY ENERGY STORAGE SYSTEM shall be in compliance with the applicable Illinois Pollution Control Board (IPCB) regulations (*35 Illinois Administrative Code*, Subtitle H: Noise, Parts 900, 901, 910).

(2) The Applicant shall submit manufacturer's sound power level characteristics and other relevant data regarding noise characteristics of proposed TIER-2 BATTERY ENERGY STORAGE SYSTEM equipment necessary for a competent noise analysis.

(3) The Applicant, through the use of a qualified professional, as part of the siting approval application process, shall appropriately demonstrate compliance with the above noise requirements as follows:

a. The SPECIAL USE Permit application for a TIER-2 BATTERY ENERGY STORAGE SYSTEM shall include a noise analysis that includes the following:

(a) The pre-development 24-hour ambient background sound level shall be identified at representative locations near the site of the proposed TIER-2 BATTERY ENERGY STORAGE SYSTEM.

(b) Computer modeling shall be used to generate the anticipated sound level resulting from the operation of the proposed TIER-2 BATTERY ENERGY STORAGE SYSTEM within 1,500 feet of the proposed TIER-2 BATTERY ENERGY STORAGE SYSTEM.

(c) Results of the ambient background sound level monitoring and the modeling of anticipated sound levels shall be clearly stated in the application and the application shall include a map of the modeled noise contours within 1,500 feet of the proposed TIER-2 BATTERY ENERGY STORAGE SYSTEM.

(d) The application shall also clearly state the assumptions of the computer model's construction and algorithms so that a

competent and objective third party can as simply as possible verify the anticipated sound data and sound levels.

(4) The Zoning Use Permit Application shall include an updated noise analysis if there are any changes in BESS equipment or any changes in BESS equipment locations from the approved Special Use Permit.

(~~4~~ 5) After construction of the TIER-2 BATTERY ENERGY STORAGE SYSTEM, the Zoning Administrator shall take appropriate enforcement action as necessary to investigate noise complaints in order to determine the validity of the complaints and take any additional enforcement action as proves warranted to stop any violation that is occurring, including but not limited to the following:

a. The Zoning Administrator shall make the Environment and Land Use Committee aware of complaints about noise.

b. If the Environment and Land Use Committee determines that the noise is excessive, the Environment and Land Use Committee shall require the Owner or Operator to take responsible steps to mitigate the excessive noise.

I. Standard Conditions for Endangered Species Consultation

The Applicant shall apply for consultation with the Endangered Species Program of the Illinois Department of Natural Resources. The Application shall include a copy of the Agency Action Report from the Endangered Species Program of the Illinois Department of Natural Resources or, if applicable, a copy of the Detailed Action Plan Report submitted to the Endangered Species Program of the Illinois Department of Natural Resources and a copy of the response from the Illinois Department of Natural Resources.

J. Standard Conditions for Historic and Archaeological Resources Review

The Applicant shall apply for consultation with the State Historic Preservation Officer of the Illinois Department of Natural Resources. The Application shall include a copy of the Agency Action Report for the State Historic Preservation Officer of the Illinois Department of Natural Resources.

K. Standard Conditions for Acceptable Wildlife Impacts

The TIER-2 BATTERY ENERGY STORAGE SYSTEM shall be located, designed, constructed, and operated so as to avoid and if necessary mitigate the impacts to wildlife to a sustainable level of mortality.

L. Screening and Fencing

(1) Perimeter fencing

a. TIER-2 BATTERY ENERGY STORAGE SYSTEM equipment and structures shall be fully enclosed and secured by a fence with a minimum height of 7 feet.

b. Knox boxes and keys shall be provided at locked entrances for emergency personnel access.

c. Vegetation between the fencing and the LOT LINE shall be maintained such that NOXIOUS WEEDS are controlled or eradicated consistent with the Illinois Noxious Weed Law (505 *ILCS* 100/1 *et. seq*.). Management of the vegetation shall be explained in the Special Use Permit ~~a~~Application.

(2) Screening

a. Areas within 10 feet on each side of the TIER-2 BATTERY ENERGY STORAGE SYSTEM shall be cleared of combustible vegetation and other combustible growth. ~~Source: DeKalb County draft ordinance~~

b A visual screen shall be provided around the perimeter of the TIER-2 BATTERY ENERGY STORAGE SYSTEM as follows:

(a) The visual screen shall be provided for any part of the TIER-2 BATTERY ENERGY STORAGE SYSTEM that is visible to and located within 1,000 feet of an existing DWELLING or residential DISTRICT except that the visual screen may not be required within the full 1,000 feet of an existing DWELLING or residential DISTRICT provided the Applicant submits a landscape plan prepared by an Illinois Registered Landscape Architect and the BOARD finds that the visual screen in the landscape plan provides adequate screening. However, the visual screen shall not be required if the TIER-2 BATTERY ENERGY STORAGE SYSTEM is not visible to a DWELLING or residential DISTRICT by virtue of the existing topography.

(b) The visual screen shall be waived if the owner(s) of a relevant DWELLING(S) have agreed in writing to waive the

screening requirement and a copy of the written waiver is submitted to the BOARD or GOVERNING BODY.

(c) The visual screen shall be a vegetated buffer as follows:

i. A vegetated visual screen buffer that shall include a continuous line of native evergreen foliage and/or native shrubs and/or native trees and/or any existing wooded area and/or plantings of tall native greases and other native flowering plants and/or an area of agricultural crop production that will conceal the TIER-2 BATTERY ENERGY STORAGE SYSTEM from view from adjacent abutting property may be authorized as an alternative visual screen subject to specific conditions.

ii. Any vegetation that is part of the approved visual screen buffer shall be maintained in perpetuity of the TIER-2 BATTERY ENERGY STORAGE SYSTEM. If the evergreen foliage below a height of 7 feet disappears over time, the screening shall be replaced.

iii. The continuous line of native evergreen foliage and/or native shrubs and/or native trees shall be planted at a minimum height of 5 feet tall and shall be planted in multiple rows as required to provide a 50% screen within 2 years of planting. The planting shall otherwise conform to Natural Resources Conservation Service Practice Standard 380 Windbreak/Shelterbreak Establishment except that the planting shall be located as close as possible to the ~~PV SOLAR FARM~~BATTERY ENERGY STORAGE SYSTEM fence while still providing adequate clearance for maintenance.

iv. A planting of tall native grasses and other native flowing plants may be used as a visual screen buffer provided that the width of planting shall be authorized by the BOARD and the planting shall otherwise be planted and maintained per the recommendations of the Natural Resources Conservation Service Practice Standard 327 Conservation Cover and further provided that the ~~PV SOLAR FARM~~BATTERY ENERGY STORAGE SYSTEM perimeter fence is opaque.

v. An area of agricultural crop production may also be authorized by the BOARD as an alternative visual screen buffer with a width of planting as authorized by the BOARD provided that the TIER-2 BATTERY ENERGY STORAGE SYSTEM perimeter fence is opaque. Any area of crop production that is used as a vegetated visual screen shall be planted annually and shall be replanted as necessary to ensure a crop every year regardless of weather or market conditions.

vi. Any vegetated screen buffer shall be detailed in a landscape plan drawing that shall be included with the TIER-2 BATTERY ENERGY STORAGE SYSTEM SPECIAL USE Permit application.

M. Standard Condition for Liability Insurance

(1) The Owner or Operator of the TIER-2 BATTERY ENERGY STORAGE SYSTEM shall maintain a current general liability policy covering bodily injury and property damage with minimum limits of at least $5 million per occurrence and $5 million in the aggregate.

(2) The general liability policy shall identify landowners in the SPECIAL USE Permit as additional insured.

N. Operational Standard Conditions

(1) Maintenance

a. Any physical modification to the TIER-2 BATTERY ENERGY STORAGE SYSTEM that increases the number of batteries or structures and/or the land area occupied by the TIER-2 BATTERY ENERGY STORAGE SYSTEM shall require a new SPECIAL USE Permit. Like-kind replacements shall not require recertification nor will replacement of equipment provided replacement is done in fashion similar to the original installation.

(2) Materials Handling, Storage and Disposal

a. All solid wastes related to the construction, operation and maintenance of the TIER-2 BATTERY ENERGY STORAGE SYSTEM shall be removed from the site promptly and disposed of in accordance with all Federal, State and local laws.

b. All hazardous materials related to the construction, operation, maintenance, and decommissioning of the TIER-2 BATTERY ENERGY STORAGE SYSTEM shall be handled, stored, transported and disposed of in accordance with all applicable local, State and Federal laws.

(3) Vegetation management

a. The TIER-2 BATTERY ENERGY STORAGE SYSTEM SPECIAL USE Permit application shall include a weed control plan for the total area of the SPECIAL USE Permit including areas both inside of and outside of the perimeter fencing.

b. The weed control plan shall ensure the control and/or eradication of NOXIOUS WEEDS consistent with the Illinois Noxious Weed Law (55 *ILCS* 100/1 *et. seq*.).

c. The weed control plan shall be explained in the application.

O. Standard Conditions for Decommissioning and Site Reclamation Plan

(1) The Applicant shall submit a signed decommissioning and site reclamation plan conforming to the requirements of paragraph 6.1.1A.

(2) In addition to the purposes listed in subparagraph 6.1.1A.4., the decommissioning and site reclamation plan shall also include provisions for anticipated repairs to any public STREET used for the purpose of reclamation of the TIER-2 BATTERY ENERGY STORAGE SYSTEM and all costs related to removal of access driveways.

(3) The decommissioning and site reclamation plan required in paragraph 6.1.1A. shall also include the following:

a. A stipulation that the applicant or successor shall notify the GOVERNING BODY by certified mail of the commencement of voluntary or involuntary bankruptcy proceeding, naming the applicant as debtor, within ten days of commencement of proceeding.

b. A stipulation that the applicant shall agree that the sale, assignment in fact or law, or such other transfer of applicant's financial interest in the TIER-2 BATTERY ENERGY STORAGE SYSTEM shall in no way affect or change the applicant's obligation to continue to comply with the terms of this plan. Any successor in interest, assignee, and all parties to the decommissioning and site

reclamation plan shall assume the terms, covenants, and obligations of this plan and agrees to assume all reclamation liability and responsibility for the TIER-2 BATTERY ENERGY STORAGE SYSTEM.

c. Authorization for the GOVERNING BODY and its authorized representatives for right of entry onto the TIER-2 BATTERY ENERGY STORAGE SYSTEM premises for the purpose of inspecting the methods of reclamation or for performing actual reclamation if necessary.

d. A stipulation that at such time as decommissioning takes place the Applicant, its successors in interest, and all parties to the decommissioning and site reclamation plan are required to enter into a Roadway Use and Repair Agreement with the relevant highway authority.

e. A stipulation that the Applicant, its successors in interest, and all parties to the decommissioning and site reclamation plan shall provide evidence of any new, additional, or substitute financing or security agreement to the Zoning Administrator throughout the operating lifetime of the project.

f. A stipulation that the Applicant, its successors in interest, and all parties to the decommissioning and site reclamation plan shall be obliged to perform the work in the decommissioning and site reclamation plan before abandoning the TIER-2 BATTERY ENERGY STORAGE SYSTEM or prior to ceasing operations of the TIER-2 BATTERY ENERGY STORAGE SYSTEM, after it has begun, other than in the ordinary course of business. This obligation shall be independent of the obligation to pay financial assurance and shall not be limited by the amount of financial assurance. The obligation to perform the reclamation work shall constitute a covenant running with the land.

g. The decommissioning and site reclamation plan shall provide for payment of any associated costs that Champaign COUNTY may incur in the event that decommissioning is actually required. Associated costs include all administrative and ancillary costs associated with drawing upon the financial assurance and performing the reclamation work and shall include but not be limited to: attorney's fees; construction management and other professional fees; and, the costs of preparing requests for proposals and bidding documents required to comply with State law or Champaign COUNTY purchasing policies.

h. Provisions for the removal of structures, debris, cabling, and associated equipment on the surface and to a level of not less than five feet below the surface, and the sequence in which removal is expected to occur. Source: Sangamon County, IL

i. A stipulation that should the decommissioning and site reclamation plan be deemed invalid by a court of competent jurisdiction the TIER-2 BATTERY ENERGY STORAGE SYSTEM SPECIAL USE Permit shall be deemed void.

j. A stipulation that the Applicant's obligation to complete the decommissioning and site reclamation plan and to pay all associated costs shall be independent of the Applicant's obligation to provide financial assurance.

k. A stipulation that the liability of the Applicant's failure to complete the decommissioning and site reclamation plan or any breach of the decommissioning and site reclamation plan requirement shall not be capped by the amount of financial assurance.

l. If the Applicant desires to remove equipment or property credited to the estimated salvage value without the concurrent replacement of the property with property of equal or greater salvage value, or if the Applicant installs equipment or property increasing the cost of decommissioning after the TIER-2 BATTERY ENERGY STORAGE SYSTEM begins operations, at any point, the Applicant shall first obtain the consent of the Zoning Administrator. If the Applicant's lien holders remove equipment or property credited to the salvage value, the Applicant shall promptly notify the Zoning Administrator. In either of these events, the total financial assurance shall be adjusted to reflect any change in total salvage value and total decommissioning costs resulting from any such removal or installation.

m. A listing of any contingencies for removing an intact operational energy storage system from service, and for removing an energy storage system from service that has been damaged by a fire or other event.

n. The Decommissioning and Site Reclamation Plan shall comply with the requirements of NFPA 855.

(4) To comply with paragraph 6.1.1A.5., the Applicant shall provide financial assurance in the form of an irrevocable letter of credit as follows:

a. At the time of SPECIAL USE Permit approval, the amount of financial assurance to be provided for the decommissioning and site reclamation plan shall be 125% of the decommissioning cost as determined in the independent engineer's cost estimate to complete the decommissioning work described in Section 6.1.1A.4.a. and 6.1.1A.4.b., and 6.1.1A.4c. and shall otherwise be compliant with Section 6.1.1A.5. except that if the TIER-2 BATTERY ENERGY STORAGE SYSTEM has a limited power warranty to provide not less than 80% nominal power output up to 25 years and proof of that warranty is provided at the time of Zoning Use Permit approval, financial assurance may be provided for the decommissioning and site reclamation plan as follows:

(a) No Zoning Use Permit to authorize construction of the TIER-2 BATTERY ENERGY STORAGE SYSTEM shall be authorized by the Zoning Administrator until the TIER-2 BATTERY ENERGY STORAGE SYSTEM owner shall provide the COUNTY with financial assurance to cover ~~10%~~ 12.5% of the decommissioning cost as determined in the independent engineer's cost estimate to complete the decommissioning work described in Sections 6.1.1A.4.a. and 6.1.1A.4.b. and 6.1.1A.4.c. and otherwise compliant with Section 6.1.1A.5.

(b) On or before the sixth anniversary of the Commercial Operation Date, the TIER-2 BATTERY ENERGY STORAGE SYSTEM Owner shall provide the COUNTY with Financial Assurance to cover ~~50%~~ 62.5% of the decommissioning cost as determined in the independent engineer's cost estimate to complete the decommissioning work described in Sections 6.1.1A.4.a. and 6.1.1A.4.b. and 6.1.1A.4.c. and otherwise compliant with Section 6.1.1A.5.

(c) On or before the eleventh anniversary of the Commercial Operation Date, the TIER-2 BATTERY ENERGY STORAGE SYSTEM Owner shall provide the COUNTY with Financial Assurance to cover ~~100%~~ 125% of the decommissioning cost as determined in the independent engineer's cost estimate to complete the decommissioning work described in Sections 6.1.1A.4.a. and 6.1.1A.4.b. and 6.1.1A.4.c. and otherwise compliant with Section 6.1.1A.5.

b. Net salvage value may be deducted for decommissioning costs as follows:

(a) One of the following standards shall be met:

i. The Applicant, its successors in interest, and all parties to the decommissioning and site reclamation plan shall maintain the TIER-2 BATTERY ENERGY STORAGE SYSTEM free and clear of liens and encumbrances, including financing liens and shall provide proof of the same prior to issuance of the SPECIAL USE Permit; or

ii. The Applicant, its successors in interest, and all parties to the decommissioning and site reclamation plan shall deduct from the salvage vale credit the amount of any lien or encumbrance on the TIER-2 BATTERY ENERGY STORAGE SYSTEM; or

iii. Any and all financing and/or financial security agreements entered into by the Applicant, its successors in interest, and all parties to the decommissioning and site reclamation plan shall expressly provide that the agreements are subject to the covenant required by Section 6.1.1A.2 that the reclamation work be done.

(b) The Applicant, its successors in interest, and all parties to the decommissioning and site reclamation plan shall provide proof of compliance with paragraph 6.1.8 O.(4).b.(a) prior to the issuance of any Zoning Use Permit and upon every renewal of the financial assurance and at any other time upon the request of the Zoning Administrator.

(c) The Applicant, its successors in interest, and all parties to the decommissioning and site reclamation plan shall provide in the decommissioning and site reclamation plan for legal transfer of the STRUCTURE to the demolisher to pay the costs of reclamation work, should the reclamation work be performed.

(d) The net estimated salvage value that is deducted from the estimated decommissioning costs shall be the salvage value that results after all related costs for demolition and any required preparation for transportation for reuse or recycling or for simple disposal and other similar costs including but not limited to the decommissioning of the TIER-2

BATTERY ENERGY STORAGE SYSTEM STRUCTURES, equipment, and access roads.

(e) Estimated salvage value shall be based on the average salvage price of the past five years as published in a reputable source for salvage values and shall reflect sound engineering judgement as to anticipated changes in salvage prices prior to the next update of estimated net salvage value.

(f) The total financial assurance after deduction of the net estimated salvage value shall not be less than $1,000 per acre.

(g) The credit for net estimated salvage value attributable to any TIER-2 BATTERY ENERGY STORAGE SYSTEM may not exceed the estimated cost of removal of the above-ground portion of that TIER-2 BATTERY ENERGY STORAGE SYSTEM on the subject site.

c. The GOVERNING BODY has the right to require multiple letters of credit based on the regulations governing federal insurance for deposits.

d. The Applicant, its successors in interest, and all parties to the decommissioning and site reclamation plan shall adjust the amount of the financial assurance to ensure that it reflects current and accurate information as follows:

(a) On the tenth anniversary of the financial assurance and at least once every five years thereafter, the Applicant, its successors in interest, and all parties to the decommissioning and site reclamation plan shall use an independent Illinois Licensed Professional Engineer to provide updated estimates of decommissioning costs and salvage value, by including any changes due to inflation and/or change in salvage price. The Applicant, its successors in interest, and all parties to the decommissioning and site reclamation plan shall, upon receipt, provide a copy of the adjusted Professional Engineer's report to the Zoning Administrator.

(b) At all times, the value of the irrevocable letter of credit shall equal or exceed the amount of the independent engineer's cost estimate as increased by known and documented rates of inflation based on the Consumer Price Index since the TIER-2 BATTERY ENERGY STORAGE SYSTEM was approved.

e. The long term corporate debt (credit) rating of the letter of credit issuing financial institution by both Standard & Poor's Financial Services LLC (S&P) and Moody's Investors Service (Moody's) shall be equal to or greater than the minimum acceptable long term corporate debt (credit) rating, as follows:

(a) The Zoning Administrator shall verify the long term corporate debt (credit) rating of the proposed financial institution by Standard and Poor's Financial Services LLC (S&P) and/or Moody's Investors Service (Moody's) and/or the Kroll Bond Rating Agency.

(b) The minimum acceptable long term corporate debt (credit) rating of the proposed financial institution shall be a rating of "A-" by S&P or a rating of "A3" by Moody's, or a rating of "A-" by Kroll Bond Rating Agency.

(c) Whenever the most current long term corporate debt (credit) rating of the proposed financial institution by either S&P, Moody's, or Kroll Bond Rating Agency is lower than the minimum acceptable long term corporate debt (credit) rating, the letter of credit shall be replaced with a new irrevocable letter of credit from an issuing financial institution whose most current long term corporate debt (credit) rating by either S&P, Moody's, or Kroll Bond Rating Agency meets or exceeds the minimum acceptable long term corporate debt (credit) rating.

f. Should the salvage value of components be adjusted downward or the decommissioning costs adjusted upward pursuant to paragraph 6.1.8 O.(4)d., the amount of the irrevocable letter of credit pursuant to this paragraph 6.1.8 O.(4) shall be increased to reflect the adjustment, as if the adjusted estimate were the initial estimate.

g. Unless the Governing Body approves otherwise, the Champaign County State's Attorney's Office shall review and approve every Letter of Credit prior to acceptance by the Zoning Administrator.

(5) In addition to the conditions listed in subparagraph 6.1.1A.9. the Zoning Administrator may also draw on the funds for the following reasons:

a. In the event that any TIER-2 BATTERY ENERGY STORAGE SYSTEM or component thereof ceases to be functional for more than six consecutive months after ~~it starts producing electricity~~ the

Zoning Compliance Certificate is issued and the Owner is not diligently repairing such TIER-2 BATTERY ENERGY STORAGE SYSTEM or component.

b. In the event that the Owner declares the TIER-2 BATTERY ENERGY STORAGE SYSTEM or any TIER-2 BATTERY ENERGY STORAGE SYSTEM component to be functionally obsolete for tax purposes.

c. There is a delay in the construction of any TIER-2 BATTERY ENERGY STORAGE SYSTEM of more than 6 months after construction on that TIER-2 BATTERY ENERGY STORAGE SYSTEM begins.

d. Any TIER-2 BATTERY ENERGY STORAGE SYSTEM or component thereof that appears in a state of disrepair or imminent collapse and/or creates an imminent threat to the health or safety of the public or any person.

e. Any TIER-2 BATTERY ENERGY STORAGE SYSTEM or component thereof that is otherwise derelict for a period of 6 months.

f. The TIER-2 BATTERY ENERGY STORAGE SYSTEM is in violation of the terms of the TIER-2 BATTERY ENERGY STORAGE SYSTEM SPECIAL USE Permit for a period exceeding ninety (90) days.

g. The Applicant, its successors in interest, and all parties to the decommissioning and site reclamation plan has failed to maintain financial assurance in the form and amount required by the SPECIAL USE Permit or compromised the COUNTY's interest in the decommissioning and site reclamation plan.

h. The COUNTY discovers any material misstatement of fact of misleading omission of fact made by the Applicant in the course of the SPECIAL USE Permit Zoning Case.

~~i. The Applicant has either failed to receive a copy of the certification of design compliance required by paragraph 6.1.8 D. or failed to submit it to the COUNTY within 12 consecutive months of receiving a Zoning Use Permit regardless of the efforts of the Applicant to obtain such certification.~~

(6) The Zoning Administrator may, but is not required to, deem the TIER-2 BATTERY ENERGY STORAGE SYSTEM abandoned, or the standards set forth in Section 6.1.8 O.(5) met, with respect to some, but not all, of the TIER-2 BATTERY ENERGY STORAGE SYSTEM. In that event, the Zoning Administrator may draw upon the financial assurance to perform the reclamation work as to that portion of the TIER-2 BATTERY ENERGY STORAGE SYSTEM only. Upon completion of that reclamation work, the salvage value and reclamation costs shall be recalculated as to the remaining TIER-2 BATTERY ENERGY STORAGE SYSTEM.

(7) The decommissioning and site reclamation plan shall be included as a condition of approval by the Board and the signed and executed irrevocable letter of credit and evidence of the escrow account must be submitted to the Zoning Administrator prior to any Zoning Use Permit approval.

P. Complaint Hotline

(1) Prior to the commencement of construction on the TIER-2 BATTERY ENERGY STORAGE SYSTEM and during the entire term of the COUNTY Board SPECIAL USE Permit and any extension, the Applicant and Owner shall establish a telephone number hotline for the general public to call with any complaints or questions.

(2) The telephone number hotline shall be publicized and posted at the operations and maintenance center and the construction marshalling yard.

(3) The telephone number hotline shall be manned during usual business hours and shall be an answering recording service during other hours.

(4) Each complaint call to the telephone number hotline shall be logged and identify the name and address of the caller and the reason for the call.

(5) All calls shall be recorded, and the recordings shall be saved for transcription for a minimum of two years.

(6) A copy of the telephone number hotline log shall be provided to the Zoning Administrator on a monthly basis.

(7) The Applicant and Owner shall take necessary actions to resolve all legitimate complaints.

Q. Standard Conditions for Expiration of TIER-2 BATTERY ENERGY STORAGE SYSTEM SPECIAL USE Permit

A TIER-2 BATTERY ENERGY STORAGE SYSTEM SPECIAL USE Permit designation shall expire in 10 years if no Zoning Use Permit is granted.

R. Application Requirements

(1) In addition to all other information required on the SPECIAL USE Permit application and required by Section 9.1.11A.3~~2~~., the application shall contain or be accompanied by the following information:

a. A TIER-2 BATTERY ENERGY STORAGE SYSTEM Project Summary, including, to the extent available:

(a) ~~(a)~~ A general description of the project, the maximum number and type of battery devices, the expected lifetime of the battery devices, any planned capacity maintenance (augmentation), and the potential equipment manufacturer(s).

(b) The specific proposed location of the TIER-2 BATTERY ENERGY STORAGE SYSTEM including all tax parcels on which the BATTERY ENERGY STORAGE SYSTEM will be constructed.

(c) A description of the Applicant, Owner and Operator, including their respective business structures.

b. The name(s), address(es), and phone number(s) of the Applicant(s), Owner and Operator, and all property owner(s) for the TIER-2 BATTERY ENERGY STORAGE SYSTEM SPECIAL USE Permit.

c. A site plan for the TIER-2 BATTERY ENERGY STORAGE SYSTEM indicating the following:

(a) The approximate planned location of all TIER-2 BATTERY ENERGY STORAGE SYSTEMS, property lines (including identification of adjoining properties), required separations, public access roads and turnout locations, access driveways, battery devices, electrical inverter(s), electrical transformer(s), electrical cabling, ancillary equipment, screening and fencing, third party transmission lines, maintenance and management facilities, and layout of all structures within the geographical boundaries of any applicable setback.

(b) The site plan shall clearly indicate the area of the proposed TIER-2 BATTERY ENERGY STORAGE SYSTEM SPECIAL USE Permit.

(c) The location of all below-ground wiring.

(d) The location, height, and appearance of all above-ground wiring and wiring structures.

(e) The separation of all TIER-2 BATTERY ENERGY STORAGE SYSTEM structures from adjacent DWELLINGS and/or PRINCIPAL BUILDINGS or uses shall be dimensioned on the approved site plan and that dimension shall establish the effective minimum separation that shall be required for any Zoning Use Permit. Greater separation and somewhat different locations may be provided in the approved site plan for the Zoning Use Permit provided that the greater separation does not increase the noise impacts that were approved in the TIER-2 BATTERY ENERGY STORAGE SYSTEM SPECIAL USE Permit.

d. An electrical diagram detailing the TIER-2 BATTERY ENERGY STORAGE SYSTEM layout, associated components, and electrical interconnection methods, with all National Electrical Code compliant disconnects and overcurrent devices. Source: Johnson County, IA

e. All other required studies, reports, certifications, and approvals demonstrating compliance with the provisions of this Ordinance.

(2) The Applicant shall notify the COUNTY of any changes to the information provided above that occurs while the SPECIAL USE Permit application is pending.

6. Add new paragraph 9.3.1 K. as follows:

K. TIER-1 BATTERY ENERGY STORAGE SYSTEM……no fee

TIER-2 BATTERY ENERGY STORAGE SYSTEM……$1800 per megawatt

7. Add new subparagraph 9.3.3 B.(9) as follows:

(9) TIER-1 BATTERY ENERGY STORAGE SYSTEM……no fee

TIER-2 BATTERY ENERGY STORAGE SYSTEM……..……$1,320 per megawatt

ATTACHMENT B~~EXHIBIT A:~~. PROPOSED AMENDMENT AS OF 12/12/~~MARCH 28,~~ 2024
Text added by ELUC at 1/4/24 meeting
Text added or ~~deleted~~ by P&Z Staff after ELUC meeting
New text added ~~or deleted~~ as of 12/12/2024

NFPA®

855

Standard for the Installation of Stationary Energy Storage Systems

2023

NFPA®

See ALERT

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ISBN: 978-145592941-2 (Print)
3 4 5 6 7 KP 28 27 26 25 24

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NFPA® 855

Standard for the

Installation of Stationary Energy Storage Systems

2023 Edition

This edition of NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems*, was prepared by the Technical Committee on Energy Storage Systems and acted on by the NFPA membership during the 2022 NFPA Technical Meeting held June 8-9. It was issued by the Standards Council on August 12, 2022, with an effective date of September 1, 2022, and supersedes the previous edition.

This document has been amended by one or more Tentative Interim Amendments (TIAs) and/or Errata. See "Codes & Standards" at www.nfpa.org for more information.

This edition of NFPA 855 was approved as an American National Standard on September 1, 2022.

Origin and Development of NFPA 855

The energy storage system project that led to the first edition of NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems*, was approved by the NFPA Standards Council in April of 2016, after which a call for members was posted. The original request was submitted by an individual on behalf of the California Energy Storage Alliance to address gaps in regulation identified in workshops held by the US Department of Energy and the Fire Protection Research Foundation. In August of that same year, the Standards Council appointed the first NFPA Technical Committee on Energy Storage Systems. The initial draft was developed over the course of three meetings by the technical committee and was released to the public in 2017. Over the next 2 years, the technical committee met several times to review feedback from the public and to make improvements to the standard.

The first edition was issued by the Standards Council on August 5, 2019.

The 2023 edition includes a scope which covers all energy storage systems and lithium battery storage. Application of NFPA 855 to an ESS installation is left to the mandatory or voluntary adoption of the standard. Exemptions specific to installations under the exclusive control of utilities have been incorporated throughout the standard to address concerns if NFPA 855 is adopted for utility use.

In response to international incidents of ESS fires, requirements for fire detection and suppression, explosion control, exhaust ventilation, gas detection, and thermal runaway have been added or revised. The requirements for fire and explosion testing (formally large-scale fire testing) have been clarified.

Requirements from Chapters 4 and 10 specific to electrochemical ESS have been consolidated and reorganized in Chapter 9. Chapter 13 has been added to address flywheel ESS.

Information has been added in Annex B to provide guidance on the hazards associated with additional battery types. Annex G has been added as a guide for suppression and safety of lithium-ion battery ESS.

Contents

NFPA 855

Standard for the

Installation of Stationary Energy Storage Systems

2023 Edition

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced and extracted publications can be found in Chapter 2 and Annex G.

Chapter 1 Administration

Δ **1.1* Scope.** This standard applies to the design, construction, installation, commissioning, operation, maintenance, and decommissioning of stationary energy storage systems (ESS), including mobile and portable ESS installed in a stationary situation and the storage of lithium metal or lithium-ion batteries.

1.2 Purpose. This standard provides the minimum requirements for mitigating the hazards associated with ESS and the storage of lithium metal or lithium-ion batteries.

1.3* Application. This standard shall apply to ESS installations exceeding the values shown in Table 1.3 and the storage of lithium metal or lithium-ion batteries.

1.3.1* ESS shall comply with the requirements of this standard as applicable.

1.3.2 ESS installed in one- and two-family dwellings and townhouse units shall only be required to comply with Chapter 15.

Δ **Table 1.3 Threshold Quantities per Each Fire Area or Outdoor Installation**

ESS Technology	Aggregate Capacity[a] kWh	MJ
Battery ESS		
Lead-acid, all types	70	252
Ni-Cad, Ni-MH, and Ni-Zn	70	252
Lithium-ion, all types	20	72
Sodium nickel chloride	20 (70[b])	72 (252[b])
Flow batteries[c]	20	72
Other battery technologies	10	36
Batteries in one- and two-family dwellings and townhouse units	1	3.6
Capacitor ESS		
Electrochemical double layer capacitors[d]	3	10.8
Other ESS		
All other ESS	70	252
Flywheel ESS (FESS)	0.5	1.8

[a]For ESS units rated in amp-hrs, kWh equals nominal rated voltage multiplied by amp-hr nameplate rating divided by 1000. For batteries rated in watts per cell, kWh equals the nameplate watts per cell multiplied by the number of cells divided by 1000 and multiplied by the nameplate minutes rating divided by 60.

[b]For sodium-nickel-chloride batteries that have been listed to UL 1973 and meet the cell-level performance requirements in UL 9540A.

[c]Includes vanadium, zinc-bromine, polysulfide-bromide, and other flowing electrolyte-type technologies.

[d]Capacitors used for power factor correction, filtering, and reactive power flow are exempt.

Δ **1.3.3** Mobile ESS deployed at an electric utility substation or generation facility for 90 days or less shall not add to the threshold values in Table 1.3 for the stationary ESS installation if both of the following conditions apply:

(1) The mobile ESS complies with 9.5.3.2.
(2) The mobile ESS is only being used during periods in which a facility's stationary ESS is being tested, repaired, retrofitted, or replaced.

N **1.3.4** The storage of lithium metal or lithium-ion batteries shall only be required to comply with Chapter 14.

1.4 Retroactivity.

1.4.1 Unless otherwise specified, the provisions of this standard shall not apply to ESS installations that existed or were approved for construction or installation prior to the effective date of this standard.

1.4.2* In those cases where the authority having jurisdiction (AHJ) determines that an existing situation presents an unacceptable degree of risk, the AHJ shall be permitted to apply retroactively any portions of this standard deemed appropriate.

1.5* Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, reliability, and safety over those prescribed in this standard.

1.6 Units and Formulas. Metric units in this standard shall be in accordance with the International System of Units, which is officially abbreviated SI in all languages.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 1, *Fire Code*, 2021 edition.

NFPA 2, *Hydrogen Technologies Code*, 2023 edition.

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*, 2022 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2022 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2022 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2022 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2021 edition.

NFPA 52, *Vehicular Natural Gas Fuel Systems Code*, 2023 edition.

NFPA 54, *National Fuel Gas Code*, 2021 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2020 edition.

NFPA 68, *Standard on Explosion Protection by Deflagration Venting*, 2018 edition.

NFPA 69, *Standard on Explosion Prevention Systems*, 2019 edition.

NFPA 70®, National Electrical Code®, 2023 edition.

NFPA 72®, National Fire Alarm and Signaling Code®, 2022 edition.

NFPA 76, *Standard for the Fire Protection of Telecommunications Facilities*, 2020 edition.

NFPA 750, *Standard on Water Mist Fire Protection Systems*, 2023 edition.

NFPA 770, *Standard on Hybrid (Water and Inert Gas) Fire-Extinguishing Systems*, 2021 edition.

NFPA 853, *Standard for the Installation of Stationary Fuel Cell Power Systems*, 2020 edition.

NFPA 1142, *Standard on Water Supplies for Suburban and Rural Firefighting*, 2022 edition.

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*, 2022 edition.

NFPA 2010, *Standard for Fixed Aerosol Fire-Extinguishing Systems*, 2020 edition.

2.3 Other Publications.

2.3.1 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI Z535.1, *American National Standard for Safety Colors*, 2011.

ANSI Z535.2, *American National Standard for Environmental and Facility Safety Signs*, 2011.

ANSI Z535.3, *American National Standard for Criteria for Safety Symbols*, 2011.

ANSI Z535.4, *American National Standard for Product Safety Signs and Labels*, 2011.

ANSI Z535.5, *American National Standard for Safety Tags and Barricade Tapes (for Temporary Hazards)*, 2011.

ANSI Z535.6, *American National Standard for Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials*, 2011.

2.3.2 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM E108, *Standard Test Methods for Fire Tests of Roof Coverings*, 2020a.

ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, 2020.

2.3.3 IAPMO Publications. International Association of Plumbing and Mechanical Officials, 4755 E. Philadelphia Street, Ontario, CA 91761.

Uniform Plumbing Code, 2021.

2.3.4 ICC Publications. International Code Council, 500 New Jersey Avenue, NW, 6th Floor, Washington, DC 20001.

International Plumbing Code, 2021.

2.3.5 IEEE Publications. IEEE, 3 Park Avenue, 17th Floor, New York, NY 10016-5997.

IEEE C2, *National Electrical Safety Code*, 2017.

2.3.6 NERC Publications. North American Electric Reliability Corporation, 1325 G Street, NW, Suite 600, Washington, DC 20005.

PRC-005-6, *Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance*, 2016.

Δ **2.3.7 UL Publications.** Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 263, *Fire Tests of Building Construction and Materials*, 2021.

UL 790, *Standard Test Methods for Fire Tests of Roof Coverings*, 2018.

UL 1012, *Power Units Other Than Class 2*, 2021.

UL 1741, *Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources*, 2021.

UL 1778, *Uninterruptible Power Systems*, 2017.

UL 1973, *Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications*, 2018.

UL 1974, *Evaluation for Repurposing Batteries*, 2018.

UL 9540, *Energy Storage Systems and Equipment*, 2020.

UL 9540A, *Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems*, 2019.

UL 60950-1, *Information Technology Equipment — Safety — Part 1: General Requirements*, 2007, revised 2019.

UL 62368-1, *Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements*, 2021.

2.3.8 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections.

NFPA 30, *Flammable and Combustible Liquids Code*, 2021 edition.

NFPA 70®, National Electrical Code®, 2023 edition.

NFPA 72®, National Fire Alarm and Signaling Code®, 2022 edition.

NFPA *101®, Life Safety Code®*, 2021 edition.

NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, 2022 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Standard. An NFPA standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA manuals of style. When used in a generic sense, such as in the phrases "standards development process" or "standards development activities," the term "standards" includes all NFPA standards, including codes, standards, recommended practices, and guides.

3.3 General Definitions.

Δ **3.3.1* Apartment Building.** A building or portion thereof containing three or more dwelling units with independent cooking and bathroom facilities. [*101*, 2021]

Δ **3.3.2 Battery.** One or more cells connected together electrically in series, parallel, or both, to provide the required operating voltage and current levels.

3.3.2.1* *Flow Battery.* A type of storage battery that includes one or more electrolyte solutions or suspensions in at least one storage tank, one or more energy converters where chemical energy is converted into electrical energy in a reversible process, and a circulation system that causes electrolyte to flow between the tank(s) and converter(s).

3.3.3* Battery Management System (BMS). A system that monitors, controls, and optimizes performance of an individual or multiple battery modules.

3.3.4 Cell. The basic electrochemical unit, characterized by an anode and a cathode, used to receive, store, and deliver electrical energy. [70:100]

Δ **3.3.5 Dwelling Unit.** One or more rooms arranged for complete, independent housekeeping purposes with space for eating, living, and sleeping; facilities for cooking; and provisions for sanitation. [*101*, 2021]

Δ **3.3.5.1* *One- and Two-Family Dwelling Unit.*** A building that contains not more than two dwelling units with independent cooking and bathroom facilities. [*101*, 2021]

Δ **3.3.5.2 *One-Family Dwelling Unit.*** A building that consists solely of one dwelling unit with independent cooking and bathroom facilities. [*101*, 2021]

Δ **3.3.5.3 *Two-Family Dwelling Unit.*** A building that consists solely of two dwelling units with independent cooking and bathroom facilities. [*101*, 2021]

Δ **3.3.6 Electric Utilities.** All enterprises engaged in the production or distribution of electricity for public use, including those that are typically designated or recognized by governmental law or regulation by public service/utility commissions and that install, operate, and maintain electric supply such as generation, transmission, or distribution systems.

3.3.7* Electrochemical Double Layer Capacitor (EDLC). A capacitor that has liquid electrolyte (e.g., acetonitrile) and electrodes with a highly porous surface that increases the surface area for holding charge resulting in much larger capacitance and energy density.

Δ **3.3.8* Energy Storage Management System (ESMS).** A system that monitors, controls, and optimizes the performance and safety of an energy storage system.

Δ **3.3.9* Energy Storage Systems (ESS).** One or more devices, assembled together, capable of storing energy to supply electrical energy at a future time.

3.3.9.1 ***Capacitor Energy Storage System.*** An electrical energy storage system using capacitors as a storage media.

3.3.9.1.1* ***Electrochemical Energy Storage System.*** An energy storage system that converts and stores chemical energy to electrical energy and vice versa.

3.3.9.1.2* ***Mechanical Energy Storage System.*** An energy storage system that converts and stores mechanical energy to electrical energy and vice versa.

Δ **3.3.9.2** ***Energy Storage System Cabinet.*** An enclosure containing components of the energy storage system where personnel cannot enter the enclosure other than reaching in to access components for maintenance purposes.

Δ **3.3.9.3** ***Energy Storage System (ESS) Dedicated-Use Building.*** A building that is only used for energy storage, or energy storage in conjunction with energy generation, electrical grid-related operations, or communications utility equipment.

Δ **3.3.9.4** ***Energy Storage System Walk-In Unit.*** A structure containing energy storage systems that includes doors that provide walk-in access for personnel to maintain, test, and service the equipment and is typically used in outdoor and mobile energy storage system applications.

3.3.9.5 ***Mobile Energy Storage System.*** An energy storage system capable of being moved and utilized as a temporary source of power.

3.3.9.6 ***Portable Energy Storage System.*** An energy storage system suitable to be lifted and moved by a single person without mechanical aids and not permanently connected to an electrical system.

3.3.9.7 ***Stationary Energy Storage System.*** An energy storage system that is permanently installed as fixed equipment.

3.3.10 Fire and Explosion Testing. Testing of a representative energy storage system that evaluates the fire and explosion hazards produced by a propagating thermal runaway.

3.3.11 Fire Area. An area of a building separated from the remainder of the building by construction having a fire resistance of at least 1 hour and having all communicating openings properly protected by an assembly having a fire resistance rating of at least 1 hour. [**30**, 2021]

Δ **3.3.12 Fire Command Center.** The principal attended or unattended room or area where the status of the detection, alarm communications, control systems, and other emergency systems is displayed and from which the system(s) can be manually controlled. [**72**, 2022]

N **3.3.13* Flywheel Energy Storage System (FESS).** A mechanical energy storage system composed of a spinning mass referred to as a rotor and an energy conversion mechanism that converts the stored mechanical energy to electrical energy.

N **3.3.13.1*** ***Braking.*** Actively removing speed from the rotor without feeding power to the input or output.

N **3.3.13.2*** ***Spin Down.*** A shutdown condition of the FESS, where energy is being dissipated and the flywheel rotor is slowing down to a stop.

N **3.3.13.3** ***Standby FESS.*** A condition of the flywheel energy storage system where the flywheel is rotating but not providing energy to external loads.

3.3.14 Hazard Mitigation Analysis (HMA). An evaluation of potential energy storage system failure modes and the safety-related consequences attributed to the failures.

Δ **3.3.15 Living Area.** Any normally occupiable space in a residential occupancy, other than sleeping rooms or rooms that are intended for combination sleeping/living, bathrooms, toilet compartments, kitchens, closets, halls, storage or utility spaces, and similar areas. [***101***, 2021]

3.3.16 Maximum Stored Energy. The quantity of energy storage permitted in a fire area prior to the area being considered a high hazard occupancy.

3.3.17 Off-Gassing. The event in which the cell case vents due to a rise in internal pressure of the cell.

3.3.18 Off-Specification Battery or Cell. A cell or battery that has been tested during the manufacturing quality control process and found not to be within the manufacturer's designed set of criteria for its intended use.

3.3.19 Open Parking Garage. A structure or portion of a structure with the openings on two or more sides that is used for the parking or storage of motor vehicles.

Δ **3.3.20 Qualified Person.** One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved. [**70**:100]

N **3.3.21 Recycle.** The process of collecting and processing materials that would otherwise be turned into trash and turning them into new products.

N **3.3.22* Repurposed Battery.** A battery that was used in one application in the field that is subject to some level of analysis and reconfiguration for use in an ESS application.

N **3.3.23 Standby Power Application.** An energy storage system utilizing a battery that is intended to remain on continuous float charge or in a high state of charge to support an event necessitating a discharge.

N **3.3.24 Storage of Batteries.** The storage, keeping, or collecting of batteries for future use as needed, or for disposal; does not include batteries undergoing manufacture or testing.

N **3.3.25 Stored-Energy Emergency Power Supply System (SEPSS).** A system consisting of a UPS, a rectifier plant, or a motor generator powered by a stored electrical energy source; a transfer switch designed to monitor preferred and alternate load power source and provide desired switching of the load; and all necessary control equipment to make the system functional. [**111**, 2022]

Δ **3.3.26* Thermal Runaway.** Self-heating of an electrochemical system in an uncontrollable fashion.

3.3.27 Utility Interactive. An energy storage system intended for use in parallel with an electric utility to supply common loads that can deliver power to the utility.

Chapter 4 General

4.1* General. The design, construction, and installation of ESS and related equipment shall comply with Chapter 4 and as supplemented or modified by the technology-specific provisions in Chapters 9 through 13.

4.2 Construction Documents.

4.2.1 General.

4.2.1.1 The plans and specifications associated with an ESS and its intended installation, replacement or renewal, commissioning, and use shall be submitted to the AHJ for approval and include the following:

(1) Location and layout diagram of the room or area in which the ESS is to be installed
(2) Details on hourly fire-resistant-rated assemblies provided or relied upon in relation to the ESS
(3) The quantities and types of ESS units
(4) Manufacturer's specifications, ratings, and listings of ESS
(5) Description of energy storage management systems and their operation
(6) Location and content of required signage
(7) Details on fire suppression, smoke or fire detection, gas detection, thermal management, ventilation, exhaust, and deflagration venting systems, if provided
(8) Support arrangement associated with the installation, including any required seismic support

4.2.1.2 Plans and specifications associated with energy storage systems owned and operated by utilities as a component of the electric grid that are considered critical infrastructure documents, in accordance with the provisions of North American Electric Reliability Corporation and other applicable governmental laws and regulations shall be made available to the AHJ for viewing based on the requirements of the applicable governmental laws and regulations.

Δ **4.2.1.3** The following test data, evaluation information, and calculations shall be provided in addition to the plans and specifications in 4.2.1.1 where required elsewhere in this standard:

(1) Fire and explosion testing data in accordance with 9.1.5
(2) Hazard mitigation analysis (HMA) in accordance with Section 4.4
(3) Calculations or modeling data to determine compliance with NFPA 68 and NFPA 69 in accordance with 9.6.5.6.3
(4) Other test data, evaluation information, or calculations as required elsewhere in this standard

4.2.1.4 If modeling data is provided, validation of the modeling results shall also be included.

4.2.2 Building Owner. The construction documents described in this section shall be provided to the building owner or the owner's authorized agent prior to the system being put in service.

4.2.3 Manuals. An operations and maintenance manual shall be provided to both the ESS owner or their authorized agent and system operator before the system is put into operation and includes the following:

(1) Submittal data stating the ESS size and selected options for each component of the system
(2) Manufacturer's operation manuals and maintenance manuals for the entire ESS or for each component of the system requiring maintenance that clearly identify the required routine maintenance actions
(3)* Contact information for a contracted service agency or responsible in-house personnel
(4) A narrative of how the ESS and its components and controls are intended to operate, including recommended operational set points
(5) A service record log that lists the schedule for all required service and maintenance actions with space for logging such actions that can be completed over time

4.2.3.1 The operations and maintenance manual shall be prepared prior to final approval of the ESS and be readily accessible to personnel responsible for the ESS.

4.2.3.2 A copy of the operations and maintenance manual shall be placed in an approved location to be accessible to AHJs and emergency responders.

4.2.4 Commissioning Plan. A commissioning plan meeting the provisions of Chapter 6 shall be provided to the building owner or their authorized agent and the AHJ.

4.3 Emergency Planning and Training.

Δ **4.3.1* General.** For ESS installations that exceed the maximum stored energy limits of Table 9.4.1, emergency planning and training shall be provided by the owner of the ESS or their authorized representative so that ESS facility operations and maintenance personnel and emergency responders can address foreseeable hazards associated with the on-site systems.

4.3.2 Facility Staff Planning and Training. For ESS installations that exceed the maximum stored energy limits of Table 9.4.1, an emergency operations plan and associated training shall be established, maintained, and conducted by ESS facility operations and maintenance personnel.

4.3.2.1 Emergency Operations Plan.

4.3.2.1.1 An emergency operations plan shall be readily available for use by facility operations and maintenance personnel.

4.3.2.1.2 For normally occupied facilities, the emergency operations plan shall be on site.

4.3.2.1.3 The plan shall be updated when conditions that affect the response considerations and procedures change.

4.3.2.1.4 The emergency operations plan shall include the following:

(1) Procedures for safe shutdown, de-energizing, or isolation of equipment and systems under emergency conditions to reduce the risk of fire, electric shock, and personal injuries, and for safe start-up following cessation of emergency conditions
(2) Procedures for inspection and testing of associated alarms, interlocks, and controls
(3)* Procedures to be followed in response to notifications of system alarms or out-of-range conditions that could signify potentially dangerous conditions, including shutting down equipment, summoning service or repair personnel, and providing agreed-upon notification to fire department personnel, if required
(4)* Emergency procedures to be followed in case of fire, explosion, release of liquids or vapors, damage to critical moving parts, or other potentially dangerous conditions

(5) Response considerations similar to a safety data sheet (SDS) that will address response safety concerns and extinguishment when an SDS is not required
(6) Procedures for dealing with ESS equipment damaged in a fire or other emergency event, including contact information for personnel qualified to safely remove damaged ESS equipment from the facility
(7) Other procedures as determined necessary by the AHJ to provide for the safety of occupants and emergency responders
(8) Procedures and schedules for conducting drills of these procedures

4.3.2.1.5 The emergency operations plan in 4.3.2.1 shall not be required for electric utility facilities under the exclusive control of the electric utility located outdoors or in building spaces used exclusively for such installations.

4.3.2.2 Facility Staff Training.

4.3.2.2.1 Personnel responsible for the operation, maintenance, repair, servicing, and response of the ESS shall be trained in the procedures included in the emergency operations plan in 4.3.2.1.

4.3.2.2.2 Refresher training shall be conducted at least annually and records of such training retained in an approved manner.

4.4 Hazard Mitigation Analysis (HMA).

Δ **4.4.1*** A hazard mitigation analysis shall be provided to the AHJ for review and approval where any of the following conditions are present:

(1) Technologies not specifically addressed in Table 1.3 are provided
(2) More than one ESS technology is provided in a single fire area where adverse interaction between the technologies is possible
(3) Where allowed as a basis for increasing maximum stored energy as specified in 9.4.1.1 and 9.4.1.2
(4) Where required by the AHJ to address a potential hazard with an ESS installation that is not addressed by existing requirements
(5) Where required for existing lithium-ion ESS systems that are not UL 9540 listed in accordance with 9.2.2.1
(6) Where required for outdoor lithium-ion battery ESS systems in accordance with 9.5.2.1

Δ **4.4.2 Failure Modes.**

Δ **4.4.2.1*** The hazard mitigation analysis shall evaluate the consequences of the following failure modes and others deemed necessary by the AHJ:

(1) A thermal runaway or mechanical failure condition in a single ESS unit
(2) Failure of an energy storage management system or protection system that is not covered by the product listing failure modes and effects analysis (FMEA)
(3) Failure of a required protection system including, but not limited to, ventilation (HVAC), exhaust ventilation, smoke detection, fire detection, fire suppression, or gas detection

4.4.2.2 Only single failure modes shall be considered for each mode given in 4.4.2.1.

Δ **4.4.3** The AHJ shall be permitted to approve the hazard mitigation analysis as documentation of the safety of the ESS installation if the consequences of the analysis demonstrate the following:

(1) Fires will be contained within unoccupied ESS rooms for the minimum duration of the fire resistance rating specified in 9.6.4.
(2) Fires and products of combustion will not prevent occupants from evacuating to a safe location.
(3) Deflagration hazards will be addressed by an explosion control or other system.

4.4.4 The hazard mitigation analysis shall be documented and made available to the AHJ and those authorized to design and operate the system.

4.4.5* Construction, equipment, and systems that are required for the ESS to comply with the hazard mitigation analysis shall be installed, tested, and maintained in accordance with this standard and the manufacturer's instructions.

4.5 Combustible Storage.

4.5.1 Combustible materials not related to the ESS shall not be stored in dedicated rooms, cabinets, or enclosures containing ESS equipment.

4.5.2 Combustible materials related to the ESS shall not be stored within 3 ft (0.9 m) from ESS equipment.

4.5.3 Combustible materials in occupied work centers shall not be stored within 3 ft (0.9 m) of ESS equipment.

4.5.4 Combustible materials in occupied work centers shall comply with Section 10.19 of NFPA 1 or other applicable fire codes.

4.5.5 Section 4.5 shall not apply to dwelling units.

4.6 Equipment.

4.6.1* Listings. ESS shall be listed in accordance with UL 9540, unless specifically exempted in other sections of this standard.

4.6.2 Repairs.

4.6.2.1 Repairs of ESS shall only be performed by qualified persons and documented in the maintenance, testing, and events log required in 4.2.3.

N **4.6.2.2** Where installed in an electrical substation or electrical power plant, repairs shall be documented in accordance with the operating practices adopted by the responsible electrical utility.

4.6.2.3 Repairs with other than identical or equivalent parts shall be considered a retrofit and comply with 4.6.3.

4.6.3 Retrofits.

4.6.3.1 Retrofits of ESS shall be approved and comply with the following unless modified in other sections:

(1) Battery systems and modules and capacitor systems and modules shall be listed in accordance with UL 1973 and installed in accordance with the manufacturer's instructions.
(2) ESS management and other monitoring systems shall be connected and installed in accordance with the manufacturer's instructions.

(3) The overall installation shall continue to comply with UL 9540 listing requirements, where applicable.
(4) Retrofits shall be documented in the maintenance, testing, and events log required in 4.2.3.

Δ **4.6.3.2*** Changing out or retrofitting existing lead-acid or nickel-cadmium batteries shall be considered repairs when there is no increase in system size or capacity greater than 10 percent from the original design.

N **4.6.3.3** Retrofitting of an ESS with a different ESS technology or chemistry shall be considered a replacement and comply with 4.6.4.

4.6.4 Replacements.

4.6.4.1 Replacement of ESS shall be considered new ESS installations and comply with the provisions applicable to new ESS.

4.6.4.2 The ESS being replaced shall be decommissioned in accordance with Chapter 8.

Δ **4.6.5 Reused Equipment.** Materials, equipment, and devices shall not be reused or reinstalled unless such elements have been reconditioned, tested, and placed in good and proper working condition and approved.

4.6.6 Increase in Power Rating or Maximum Stored Energy.

4.6.6.1 A complete new ESS that is added to an existing installation of one or more systems shall be treated as a new system and meet the applicable requirements of this standard.

4.6.6.2 An increase in maximum stored energy or power rating to an existing ESS shall be considered a retrofit and comply with 4.6.3.

N **4.6.6.3** Where the original ESS was approved for the addition of maximum stored energy or power over the life of the asset without adding a new technology or adding different components, and the protection systems were designed, built, and tested to handle the anticipated maximum energy or power, this installation of additional energy storage shall be considered a retrofit and comply with 4.6.3.

4.6.7 Environment. The temperature, humidity, and other environmental conditions in which an ESS is located shall be maintained in accordance with the listing and the manufacturer's specifications.

4.6.8 Charge Controllers.

4.6.8.1 Charge controllers shall be compatible with the battery or ESS manufacturer's electrical ratings and charging specifications.

4.6.8.2 Charge controllers shall be listed and labeled for the application or be provided as part of a listed ESS.

4.6.9 Inverters and Converters.

4.6.9.1* Inverters and converters shall be listed and labeled for the application.

4.6.9.2* Only units listed and labeled for utility interactive system use and identified as interactive shall be allowed to operate in parallel with the electric utility power system.

4.6.10* Energy Storage Management System (ESMS). Where required elsewhere in this standard, areas containing ESS shall be provided with an ESMS or BMS, unless modified in Chapters 9 through 13.

4.6.11* ESS Toxic and Highly Toxic Gas Release During Normal Use. ESS shall not release toxic or highly toxic gases during normal charging, discharging, and use.

4.6.12 Enclosures.

4.6.12.1 Enclosures shall be of noncombustible construction.

4.6.12.2 ESS electrical circuitry shall be within weatherproof enclosures marked with the environmental rating suitable for the type of exposure required by *NFPA 70*.

4.7 Installation. ESS shall be installed in accordance with their listing, the manufacturer's installation instructions, and this standard.

4.7.1* Electrical Installation. The electrical installation shall be in accordance with *NFPA 70* or IEEE C2 based on the location of the ESS in relation to and its interaction with the electrical grid.

N **4.7.1.1** Lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc that are in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces used exclusively for such installations that are in compliance with NFPA 76 shall not be required to comply with 4.7.1.

N **4.7.1.2** Lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations shall not be required to comply with 4.7.1.

4.7.2 Seismic Protection. ESS shall be seismically braced in accordance with the local building code.

4.7.3 Design Loads. The weight of the ESS and all associated equipment, components, and enclosure elements and their impact on the dead and live loads of the building or system foundation shall be in accordance with the local building code.

4.7.4* Signage.

4.7.4.1 Approved signage shall be provided in the following locations:

(1) On the front of doors to rooms or areas containing ESS or in approved locations near entrances to ESS rooms
(2) On the front of doors to outdoor occupiable ESS containers
(3) In approved locations on outdoor ESS that are not enclosed in occupiable containers or otherwise enclosed

Δ **4.7.4.2*** The signage required in 4.7.4.1 shall be in compliance with ANSI Z535 and include the following information as shown in Figure 4.7.4.2:

(1) "Energy Storage Systems" with symbol of lightning bolt in a triangle
(2) Type of technology associated with the ESS
(3) Special hazards associated as identified in Chapters 9 through 15
(4) Type of suppression system installed in the area of the ESS
(5) Emergency contact information

4.7.4.3 A permanent plaque or directory denoting the location of the disconnecting means for all ESS on or in the premises shall be installed at each service equipment location and at the location(s) of the system disconnect(s) for all ESS capable of being interconnected.

4.7.4.3.1 Energy storage located on property that is under the exclusive control of utilities, secured from public access, and in accordance with 90.2(D)(5) of *NFPA 70* shall not be required to comply with 4.7.4.3.

4.7.4.3.2 Lead-acid and nickel-cadmium battery systems less than 50 V ac or 60 V dc in telecommunications facilities that are covered by and in compliance with NFPA 76 and secured from public access shall not be required to comply with 4.7.4.3.

4.7.4.4 Existing ESS shall be permitted to retain the signage required at installation except as modified by 4.7.4.5.

4.7.4.5 Existing ESS signage shall be updated to comply with the requirements for new ESS installations when the system is retrofitted or existing signs need to be replaced.

Δ **4.7.4.6** Battery and ESS cabinets in occupied work centers covered by 9.5.1.2.1 shall be provided with exterior signs that identify the manufacturer and model number of the system and electrical rating (voltage and current) of the contained system, and any relevant electrical, chemical, and fire hazard.

4.7.5 Impact Protection.

4.7.5.1 ESS shall be located or protected to prevent physical damage from impact where such risks are identified.

4.7.5.2 Vehicle impact protection consisting of guard posts or other approved means shall be provided where ESS are subject to impact by motor vehicles.

4.7.5.3* When guard posts are installed, they shall be designed as follows:

(1) Posts shall be constructed of steel not less than 4 in. (100 mm) in diameter.
(2) Posts shall be filled with concrete.
(3) Posts shall be spaced not more than 4 ft (1.2 m) on center.
(4) Posts shall be set not less than 3 ft (0.9 m) deep in a concrete footing of not less than 15 in. (380 mm) diameter.
(5) The top of the posts shall be set not less than 3 ft (0.9 m) above ground.
(6) Posts shall be located not less than 3 ft (0.9 m) from the ESS.

4.7.5.4* For residential garages, ESS shall not be installed in a location where subject to damage from impact by a motor vehicle.

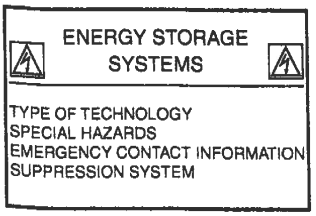


FIGURE 4.7.4.2 Example of ESS Signage.

4.7.6 Security of Installations.

4.7.6.1 ESS shall be secured against unauthorized entry and safeguarded in an approved manner.

4.7.6.2 Security barriers, fences, landscaping, and other enclosures shall not inhibit the required air flow to or exhaust from the ESS and its components.

4.7.7 Elevation. ESS shall be located only on floors that can be accessed by external fire department laddering capabilities unless a higher location is approved by the AHJ.

4.7.7.1 Belowgrade Installations.

4.7.7.1.1 ESS installations where the floor level is below the finished floor of the lowest level of exit discharge shall not be permitted unless the location is approved by the AHJ.

4.7.7.1.2 The ESS shall not be located inside an electrical room.

4.7.7.1.3 The ESS shall be accessible to emergency responders without traversing through an electrical room.

4.7.7.1.4 When approved by the AHJ, ESS installations in underground vaults constructed in accordance with Part III of Article 450 of *NFPA 70* shall be permitted.

4.7.7.2 When approved by the AHJ, ESS installations on rooftops of buildings that do not obstruct fire department rooftop operations shall be permitted.

Δ **4.7.7.3** The requirements in 4.7.7 shall not apply to the following:

(1)* Lead-acid and nickel-cadmium battery systems less than 50 V ac or 60 V dc in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces used exclusively for such installations that comply with NFPA 76
(2)* Lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations
(3) Lead-acid battery systems utilized exclusively in uninterruptable power supplies listed for their application and used for standby power applications, and limited to not more than 10 percent of the floor area on the floor on which the ESS is located

4.7.8 Means of Egress.

4.7.8.1 All areas containing ESS shall provide egress from the area in which they are located in accordance with the local building code.

4.7.8.2 Required egress doors shall be provided with emergency lighting as required by the local building code.

N **4.7.8.3** Required egress door(s) shall open in the direction of egress.

N **4.7.8.4** Required egress doors shall be equipped with listed panic hardware.

4.7.9 Open Rack Installations. Where installed in a room accessible only to authorized personnel, ESS shall be permitted to be installed on an open rack.

4.7.10 Fire Command Centers. In buildings containing ESS and equipped with a fire command center, the command center shall include signage or readily available documentation that describes the location and type of ESS, operating voltages, and location of electrical disconnects as required by *NFPA 70*.

4.7.11 Access Roads. Fire department access roads shall be provided to outdoor ESS installations in accordance with the local fire code.

4.7.12* Hazardous (Classified) Locations. The ESS shall not be located in a classified area as defined in *NFPA 70* or IEEE C2 unless listed and approved for the specific installation.

N **4.7.13 Fire Barriers.** Rooms or spaces containing ESS shall be separated from other areas of the building by fire barriers with a minimum 2-hour fire resistance rating and horizontal assemblies with a minimum 2-hour fire resistance rating and constructed in accordance with the local building code, unless modified in Chapters 9 through 13.

4.8 Smoke and Fire Detection.

Δ **4.8.1*** Where required elsewhere in this standard, areas containing ESS systems shall be provided with a smoke detection or radiant energy–sensing system in accordance with *NFPA 72*, unless modified by the requirements in Chapters 9 through 13.

4.8.1.1* Normally unoccupied, remote standalone telecommunications structures with a gross floor area of less than 1500 ft^2 (139 m^2) using lead-acid or nickel-cadmium battery technology shall not be required to have the detection required in 4.8.1.

Δ **4.8.1.2*** Lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations shall be allowed to use the process control system to monitor the smoke detectors required in 4.8.1.

Δ **4.8.2 Annunciation.**

N **4.8.2.1** All required annunciation means shall be located as required by the authority having jurisdiction to facilitate an efficient response to the situation. [**72:**10.18.3.2]

N **4.8.2.2*** Multiple panels shall be aggregated to a master or annunciator panel at a location approved by the AHJ.

N **4.8.3*** Smoke and fire detection systems protecting an ESS with lithium-ion batteries shall be required to provide a secondary power supply in accordance with *NFPA 72* capable of 24 hours in standby and 2 hours in alarm.

N **4.8.4** Alarm signals from detection systems shall be transmitted to a supervising station in accordance with *NFPA 72*.

4.9 Fire Control and Suppression.

4.9.1* Where required elsewhere in this standard, fire control and suppression for rooms or areas within buildings and outdoor walk-in units containing ESS shall be provided in accordance with this section, unless modified in Chapters 9 through 13.

4.9.1.1* Lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc that are in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces used exclusively for such installations that comply with NFPA 76 shall not be required to have a fire suppression system installed.

4.9.1.2 Lead-acid battery systems in uninterruptable power supplies listed and labeled in accordance with the application utilized for standby power applications, which is limited to not more than 10 percent of the floor area on the floor on which the ESS is located, shall not be required to have a fire suppression system installed.

Δ **4.9.1.3*** Lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations shall not be required to have a fire suppression system installed.

4.9.1.4 When approved by the AHJ, ESS shall be permitted to be installed in open parking garages without the protection of an automatic fire suppression system where fire, explosion, and fault condition testing documents the system does not present an exposure hazard to parked vehicles when installed in accordance with manufacturer's instructions and this standard.

4.9.1.5 When approved by the AHJ, ESS shall be permitted to be installed in ESS dedicated-use buildings without the protection of an automatic fire control and suppression system where fire and explosion testing conducted in accordance with 9.1.5 documents that an ESS fire does not compromise the means of egress and does not present an exposure hazard to buildings, lot lines, public ways, stored combustible materials, hazardous materials, high-piled stock, and other exposure hazards not associated with electrical grid infrastructure.

4.9.1.6 When approved by the AHJ, ESS shall be permitted to be installed in outdoor walk-in enclosures without the protection of an automatic fire control and suppression system where fire and explosion testing conducted in accordance with 9.1.5 documents that an ESS fire does not compromise the means of egress and does not present an exposure hazard in accordance with 9.5.2.6.1 and 9.5.2.6.1.7.

4.9.2 Sprinkler System. Sprinkler systems shall be installed in accordance with NFPA 13 or equivalent.

4.9.2.1 Sprinkler systems for ESS units (groups) with a maximum stored energy of 50 kWh, as described in 9.4.2.1, shall be designed using a minimum density of 0.3 gpm/ft^2 (12.2 mm/min) based over the area of the room or 2500 ft^2 (230 m^2) design area, whichever is smaller, unless a lower density is approved based upon fire and explosion testing in accordance with 9.1.5.

4.9.2.2* Sprinkler systems for ESS units (groups) exceeding 50 kWh shall use a density based on fire and explosion testing in accordance with 9.1.5.

4.9.3 Alternate Automatic Fire Control and Suppression Systems.

4.9.3.1* Other automatic fire control and suppression systems shall be permitted based on reports issued as a result of fire and explosion testing in accordance with 9.1.5.

4.9.3.2* The automatic fire control and suppression systems shall comply with the following standards, or their equivalent, as appropriate:

(1) NFPA 12
(2) NFPA 15
(3) NFPA 750
(4) NFPA 770
(5) NFPA 2001
(6) NFPA 2010

4.9.4 Water Supply.

4.9.4.1* Where required elsewhere in this standard, sites where nonmechanical ESS are installed shall be provided with a permanent source of water for fire protection, unless modified in Chapters 9 through 13.

4.9.4.2 Where no permanent adequate and reliable water supply exists for firefighting purposes, the requirements of NFPA 1142 shall apply.

4.9.4.3 Accessible fire hydrants shall be provided for site ESS installations where a public or private water supply is available.

4.9.4.4 Fire hydrants installed on private fire service mains shall be installed in accordance with NFPA 24 or equivalent local requirement where NFPA 24 is not adopted.

N **4.10 Mobile ESS Equipment and Operations.** Mobile ESS equipment and operations shall comply with 9.5.3.2, as applicable.

Chapter 5 System Interconnections

5.1 General. System interconnections shall comply with Section 5.2 through Section 5.4, as applicable.

Δ **5.2 Disconnecting Means.** A readily accessible disconnecting means for the ESS shall be provided.

N **5.2.1** Lead-acid and nickel-cadmium battery systems less than 60 V dc shall not be required to comply with Section 5.2.

N **5.2.2** Lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations shall not be required to comply with Section 5.2.

5.3 Nonelectrical Systems.

Δ **5.3.1 Natural Gas.** Piping, valves, and fittings from the outlet of the supplier's piping to the outlet of the ESS shutoff valve shall be in accordance with NFPA 54.

5.3.2 Compressed Natural Gas (CNG). The design, location, and installation of piping, valves, and fittings from the outlet of the point of delivery from the supplier to the inlets of the equipment shutoff valves shall be in accordance with NFPA 52.

5.3.3 Liquefied Petroleum Gas (LP-Gas) Systems and Storage. The design, location, and installation of liquefied petroleum gas (LP-Gas) storage and piping systems shall comply with NFPA 58.

5.3.4 Hydrogen Fuel Systems and Storage. The design, location, and installation of hydrogen gas and liquid hydrogen storage and piping systems shall comply with NFPA 2.

5.3.5 Biogas. Storage tanks and their associated equipment, piping, valves, and regulators shall be designed and installed in accordance with NFPA 54.

5.3.6 Liquid Fuels. The design of liquid fuel piping systems and the location and storage of liquid fuels shall be in accordance with NFPA 30.

Δ **5.3.7 Water.** Where the ESS requires a permanent water supply to operate, it shall be provided through a connection to an on-site water supply in accordance with ICC's *International Plumbing Code*, IAPMO's *Uniform Plumbing Code*, or local regulations; or through a self-contained water source.

5.4* Support Systems. All connections to and from an ESS or the components of an ESS to required plumbing, fire alarm, detection, or control circuits or to ventilation systems shall be in accordance with nationally recognized standards applicable to those systems, manufacturer's instructions, listings, and the applicable provisions of Chapters 4 and 5.

Chapter 6 Commissioning

6.1 System Commissioning.

Δ **6.1.1** ESS shall be evaluated and confirmed for proper operation by the system owner or their designated agent.

Δ **6.1.1.1** Lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc that are in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces or walk-in units used exclusively for such installations that comply with NFPA 76 shall be permitted to have a commissioning plan complying with recognized industry practices in lieu of complying with 6.1.5.2.

Δ **6.1.1.2*** Lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utilities and located in building spaces or walk-in units used exclusively for such installations shall be permitted to have a commissioning plan in accordance with applicable governmental laws and regulations in lieu of developing a commissioning plan in accordance with 6.1.5.2.

Δ **6.1.2** System commissioning shall be conducted after the installation is complete but prior to final inspection and approval.

N **6.1.3 Commissioning Plan.**

6.1.3.1 The system installer or commissioning agent shall prepare a written commissioning plan that provides a description of the means and methods necessary to document and verify that the system and its associated controls and safety systems, as required by this standard, are in proper working condition.

Δ **6.1.3.2** The commissioning plan shall include, but not be limited to, the following information:

(1) An overview of the commissioning process developed specifically for the ESS to be installed and narrative description of the activities to be conducted
(2) Roles and responsibilities for all those involved in the design, commissioning, construction, installation, or operation of the system(s)

(3) Means and methods whereby the commissioning plan will be made available during the implementation of the ESS project(s)
(4) Plans and specifications necessary to understand the operation of the ESS and all associated operational controls and safety systems
(5) A detailed description of each activity to be conducted during the commissioning process, who will perform each activity, and at what point in time the activity is to be conducted
(6) Procedures to be used in documenting the proper operation of the ESS and all associated operational controls and safety systems
(7) Testing for any required fire detection or suppression and thermal management, ventilation, or exhaust systems associated with the installation and verification of proper operation of the safety controls
(8) The following documentation:
    (a) Commissioning checklist
    (b) Relevant operational testing forms
    (c) Necessary commissioning logs
    (d) Progress reports
(9) Means and methods whereby facility operation and maintenance staff will be trained on the system
(10) Identification of personnel who are qualified to service and maintain the system and respond to incidents involving each system
(11) A decommissioning plan meeting the provisions of Section 8.1 that covers the removal of the system from service and from the facility in which it is located and information on disposal of materials associated with each ESS

6.1.4 Commissioning Test.

6.1.4.1 ESS shall be evaluated for their proper operation by the system installer in accordance with the manufacturer's instructions, the commissioning plan, and the requirements of this section after the installation is complete but prior to final approval.

6.1.4.2 System testing shall be conducted as a component of the commissioning process and include functional performance testing of the ESS that demonstrates that the installation and operation of the system and associated components, controls, and safety-related systems are in accordance with approved plans and specifications and that the operation, function, and maintenance serviceability for each of the commissioned ESS is confirmed.

N **6.1.5 Commissioning Report.**

Δ **6.1.5.1** The commissioning report shall be provided by the system installer or commissioning agent to the system(s) owner and the AHJ prior to final inspection and approval.

Δ **6.1.5.2** The commissioning report shall document the commissioning process and the results in accordance with 6.1.5.2.1, 6.1.5.2.2, and 6.1.5.2.3.

Δ **6.1.5.2.1** A commissioning report shall summarize the commissioning process and verify the proper operation of the system and associated operational controls and safety systems.

6.1.5.2.2 The report shall include the final commissioning plan, the results of the commissioning process, and a copy of the plans and specifications associated with the as-built system design and installation.

6.1.5.2.3 The report shall include any issues identified during commissioning and the measures taken to resolve them.

N **6.1.5.3 Corrective Action Plan.**

6.1.5.3.1 A corrective action plan acceptable to the AHJ shall be developed for any open or continuing issues that are allowed to be continued after commissioning.

N **6.1.5.3.2** The corrective action plan shall be accepted by the AHJ prior to the ESS being placed into service.

N **6.1.5.4** A copy of the commissioning report shall be kept with the ESS operations and maintenance manuals required by 4.2.3.

6.2 Issues and Resolutions Documentation. (Reserved)

6.3 Operations and Maintenance Documentation.

6.3.1 Operations and maintenance documentation shall be provided to the ESS owner.

6.3.2 The documentation shall include design, construction, installation, testing, and commissioning information associated with the ESS as initially approved after being commissioned.

6.3.3 A copy of the documentation shall be placed in an approved location to be accessible to facility personnel, fire code officials, and emergency responders.

6.4* Recommissioning of Existing Systems.

6.4.1 Recommissioning shall meet the provisions of Section 6.1 and include the entire system with issuance of a new commissioning report, identification of any new issues and resolutions documentation, and identification of any revisions to the operations and maintenance documentation.

6.4.2* When alterations, additions, repositioning, or renovations to the system or any of its components are warranted, they shall be permitted in accordance with Chapter 4 and be performed by qualified entities and the system recommissioned in accordance with Section 6.1.

6.4.3 Repairs or renewals to systems utilizing identical components shall not require recommissioning.

6.4.4* Listed ESS that has been modified in the field beyond the field-installed options that are part of the listing shall be investigated and found suitable by the organization that listed the equipment.

Chapter 7 Operation and Maintenance

7.1 System Operation. All ESS shall be operated in accordance with the manufacturer's instructions and the operation and maintenance documentation.

7.1.1 Electric Utilities Under NERC Jurisdiction.

7.1.1.1 Electric utilities under NERC jurisdiction shall comply with NERC PRC-005 requirements.

Δ **7.1.1.2** Electric utilities under NERC jurisdiction shall not be required to follow manufacturer's instructions for lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of

generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations.

Δ **7.1.2** The operation and maintenance documentation shall include the following:

(1) Procedures for the safe startup of the ESS system and associated equipment
(2) Procedures for inspection and testing of associated alarms, interlocks, and controls
(3) Procedures for maintenance and operation of the following, where applicable:
  (a) Energy storage management systems (ESMS)
  (b) Fire protection equipment and systems
  (c) Spill control and neutralization systems
  (d) Exhaust and ventilation equipment and systems
  (e) Gas detection systems
  (f) Other required safety equipment and systems
(4) Response considerations similar to a safety data sheet (SDS) that address response safety concerns and extinguishment where an SDS is not required
(5)* An instruction that equipment or system changes to the installation are required to be recorded by updating any engineering documentation

7.1.3 SDS for Hazardous Materials.

7.1.3.1 SDS for hazardous materials contained in the ESS shall be posted within sight of the disconnecting means of any ESS or at a location approved by the AHJ.

Δ **7.1.3.2** For ESS located outdoors, a means shall be provided to protect the SDS from the weather.

7.1.4 Where the operations and maintenance documentation calls for detailed procedures to be used for specific scheduled operational checks or assessments, an operations record that includes data associated with configurable system settings, system start-up, system shutdown (including emergency shutdown), and long-term shutdown (storage mode) shall be maintained by the system owner or their designated agent and be made available to the AHJ upon request.

7.1.5 The operations record shall be kept in a readily accessible location, or a sign indicating where the record is located shall be posted adjacent to the system.

Δ **7.1.5.1** For normally occupied facilities, the operations record shall be on site.

Δ **7.1.5.2** The operations record shall be permitted to be made available electronically.

7.2* System Maintenance. The ESS shall be maintained in accordance with the system manufacturer's instructions.

7.2.1 The maintenance documentation shall include a detailed maintenance schedule covering all affected equipment and the activities to be performed.

7.2.2 Maintenance shall be performed by qualified individuals.

7.2.3 Maintenance documentation indicating the maintenance action taken, the date of the action, who implemented the action, and the results associated with the action shall be maintained as required by Section 6.3.

7.2.4 Maintenance documentation shall record information on any repair, renewal, or renovation made to the ESS.

7.2.5 Training. Training shall be provided to all those responsible for system operation and maintenance.

7.2.5.1 Training on system operation and maintenance shall be provided by the system owner or their designated agent.

7.2.5.2 After recommissioning the system, training on any changes to the operation and maintenance documentation shall be provided.

7.2.5.3 Training records of site operations and maintenance personnel shall be retained and accessible to the AHJ, indicating the training taken, the name(s) of those taking the training, and the training date.

7.3 System Testing.

7.3.1 System testing shall be performed when required by the operating instructions or maintenance documentation in accordance with testing procedures provided by the ESS manufacturer.

7.3.2 A record of all testing shall be maintained in accordance with the requirements in Section 6.3.

N **7.3.2.1** Testing records shall be permitted to be made available electronically.

Chapter 8 Decommissioning

8.1 Decommissioning Plan. Prior to decommissioning, the owner of an ESS or their designated agent(s) shall prepare a written decommissioning plan complying with 8.1.3 that provides the organization, documentation requirements, and methods and tools necessary to indicate how the safety systems as required by this standard and the ESS and its components will be decommissioned and the ESS removed from the site.

Δ **8.1.1** Lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc that are in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces or walk-in units used exclusively for such installations that are in compliance with NFPA 76 shall be permitted to have a decommissioning plan in compliance with recognized industry practices in lieu of complying with 8.1.3.

Δ **8.1.2*** Lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utilities and located outdoors or in building spaces used exclusively for such installations shall be permitted to have a decommissioning plan complying with applicable governmental laws and regulations in lieu of complying with 8.1.3.

8.1.3* The decommissioning plan shall be provided to the AHJ and include the following information:

(1) An overview of the decommissioning process developed specifically for the ESS that is to be decommissioned
(2) Roles and responsibilities for all those involved in the decommissioning of the ESS and their removal from the site
(3) Means and methods in the decommissioning plan submitted during the permitting process to be made available at

a point in time corresponding to the decision to decommission the ESS

(4) Plans and specifications necessary to understand the ESS and all associated operational controls and safety systems, as built, operated, and maintained

(5) A detailed description of each activity to be conducted during the decommissioning process and who will perform that activity and at what point in time

(6) Procedures to be used in documenting the ESS and all associated operational controls and safety systems that have been decommissioned

(7) Guidelines and format for a decommissioning checklist and relevant operational testing forms and necessary decommissioning logs and progress reports

(8) A description of how any changes to the surrounding areas and other systems adjacent to the ESS, including, but not limited to, structural elements, building penetrations, means of egress, and required fire detection and suppression systems, will be protected during decommissioning and confirmed as being acceptable after the system is removed

8.2 Decommissioning Process.

8.2.1 The AHJ shall be notified prior to decommissioning an ESS.

8.2.2 The ESS shall be decommissioned by the owner of the ESS or their designated agent(s) in accordance with the decommissioning plan.

8.3 Decommissioning Report. A decommissioning report shall be prepared by the ESS owner or their designated agent and summarize the decommissioning process of the system and associated operational controls and safety systems.

8.3.1 The report shall include the final decommissioning plan and the results of the decommissioning process.

8.3.2 The report shall include any issues identified during decommissioning and the measures taken to resolve them.

N **8.3.3** The decommissioning report shall be retained by the owner and provided to the AHJ upon request.

Chapter 9 Electrochemical Energy Storage Systems

9.1 General.

9.1.1* The requirements of this chapter shall apply to installations of electrochemical ESS, including, but not limited to, battery ESS and electrochemical double-layer capacitator (EDLC) ESS.

N **9.1.2** This chapter shall not apply to surge capacitors installed in accordance with Article 460 of *NFPA 70*.

N **9.1.3*** This chapter shall not apply to capacitors and capacitor equipment for electric utilities and industrial facilities used in applications such as flexible ac transmission (FACTS) devices, filter capacitor banks, power factor correction, and standalone capacitor banks for voltage correction and stabilization.

9.1.4 Unless modified by this chapter, the requirements of Chapters 4 through 8 shall also apply.

N **9.1.5 Fire and Explosion Testing.**

N **9.1.5.1*** Where required elsewhere in this standard, fire and explosion testing in accordance with 9.1.5 shall be conducted on a representative ESS in accordance with UL 9540A or equivalent test standard.

N **9.1.5.1.1** Lead-acid and nickel-cadmium batteries used in standby power systems and listed to UL 1973 shall not require UL 9540A testing when they are installed with a charging system that is listed to UL 1012, UL 60950-1, or UL 62368-1, or a UPS listed to UL 1778.

N **9.1.5.1.2** The testing shall be conducted or witnessed and reported by an approved testing laboratory to characterize the composition of the gases generated and show that a fire involving one ESS unit will not propagate to an adjacent unit.

N **9.1.5.1.3*** The representative cell, modules, and units tested, including any optional integral fire suppression system, shall match the intended installation configuration other than the addition of the cell failure mechanism utilized for cell thermal runaway initiation.

N **9.1.5.1.4** The testing shall include evaluation of deflagration mitigation measures when designed into ESS cabinets.

N **9.1.5.2* Test Reports.**

N **9.1.5.2.1** The complete test report and its supporting data shall be provided to the AHJ for review and approval.

N **9.1.5.2.2** The test report shall be accompanied by a supplemental report prepared by a registered design professional with expertise in fire protection engineering that provides interpretation of the test data in relation to the installation requirements for the ESS.

N **9.2 Equipment.**

N **9.2.1 Listing.**

N **9.2.1.1** ESS shall be listed in accordance with UL 9540, unless specifically exempted elsewhere in this standard.

N **9.2.1.2 Lead-Acid and Nickel-Cadmium Battery Systems.**

N **9.2.1.2.1*** Lead-acid and nickel-cadmium batteries, where used in a stationary standby service with 600 V dc or less, shall be permitted to be listed to UL 1973.

N **9.2.1.2.2*** Lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities used in stationary standby service and located outdoors or in building spaces used exclusively for such installations that comply with NFPA 76 shall not be required to be listed in accordance with UL 9540.

N **9.2.1.2.3*** Lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations shall not be required to be listed in accordance with UL 9540.

N **9.2.1.2.4** Lead-acid battery systems in uninterruptable power supplies listed and labeled in accordance with UL 1778 and utilized for standby power applications, which are limited to not more than 10 percent of the floor area on the floor on

which the ESS is located, shall not be required to be listed in accordance with UL 9540.

N **9.2.2 HMA for Existing Lithium-Ion ESS.**

N **9.2.2.1** Existing lithium-ion ESS that are not UL 9540 listed shall require a hazard mitigation analysis in accordance with Section 4.4.

N **9.2.2.2** Lithium-ion ESS shall be upgraded with additional hazard mitigation measures where required by the AHJ based on the findings in the hazard mitigation analysis.

N **9.2.3 Energy Storage Management System (ESMS).**

N **9.2.3.1*** Where required by the equipment listing in accordance with 4.6.1 or the hazard mitigation analysis in accordance with Section 4.4, an approved ESMS or BMS shall be provided for monitoring operating conditions and maintaining voltages, currents, and temperatures within the manufacturer's specifications, unless modified in accordance with Chapters 9 through 13.

N **9.2.3.2*** The ESMS or BMS shall electrically isolate the ESS or affected components of the ESS or place the system in a safe condition if potentially hazardous conditions are detected.

N **9.2.3.3*** When required by the AHJ, visible annunciation shall be provided on the cabinet exterior or in an approved location to indicate potentially hazardous conditions associated with the ESS exist.

N **9.2.3.4 Lead-Acid and Nickel-Cadmium Battery Systems.**

N **9.2.3.4.1*** Lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities located outdoors or in building spaces used exclusively for such installations that comply with NFPA 76 shall not be required to comply with 9.2.3.1 through 9.2.3.3.

N **9.2.3.4.2*** Lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations shall not be required to comply with 9.2.3.1 through 9.2.3.3.

N **9.2.3.4.3** Lead-acid and nickel-cadmium battery systems in uninterruptable power supplies listed and labeled in accordance with UL 1778 and used in standby power applications shall not be required to comply with 9.2.3.1 through 9.2.3.3.

N **9.2.4 Repurposed and Refurbished Batteries.**

N **9.2.4.1** Batteries that have been repurposed or refurbished shall meet the applicable technology-specific requirements in Table 9.6.5.

N **9.2.4.2*** Batteries previously used in other applications, such as electric vehicle propulsion, shall not be permitted unless the equipment is repurposed by a UL 1974–compliant battery repurposing company where reused in ESS applications and the system complies with 4.6.1.

N **9.3 Location Classification.** Installation locations shall be classified as specified in 9.3.1 or 9.3.2.

N **9.3.1 Indoor Installations.** Indoor installations shall be classified in accordance with 9.3.1.1 or 9.3.1.2.

N **9.3.1.1 Energy Storage System (ESS) Dedicated-Use Buildings.** ESS dedicated-use buildings shall be constructed in accordance with local building codes and comply with all the following:

(1) The building shall only be used for energy storage, or energy storage in conjunction with energy generation, electrical grid-related operations, or communications utility equipment.
(2) Occupants in the rooms and areas containing ESS shall be limited to personnel that operate, maintain, service, test, and repair the ESS and other energy or communication systems.
(3) No other occupancy types shall be permitted in the building.
(4) Administrative and support personnel shall be permitted in incidental-use areas within the buildings that do not contain ESS if the following conditions are met:
    (a) The areas do not occupy more than 10 percent of the building area of the story in which they are located.
    (b) The areas are separated from the ESS and other rooms and areas containing ESS by 2-hour fire barriers and 2-hour fire-resistance-rated horizontal assemblies constructed in accordance with the local building code, as appropriate.
    (c) A means of egress is provided from the incidental-use areas to a public way that does not require occupants to traverse through areas containing ESS or other energy systems.

N **9.3.1.2 Non-Dedicated-Use Buildings.** Non-dedicated-use buildings shall include all buildings that contain ESS and do not comply with ESS dedicated-use building requirements in 9.3.1.1.

N **9.3.2 Outdoor Installations.** Outdoor ESS installations shall be classified as follows:

(1) *Remote locations*: ESS located more than 100 ft (30.5 m) from buildings, lot lines that can be built upon, public ways, stored combustible materials, hazardous materials, high-piled stock, and other exposure hazards not associated with electrical grid infrastructure
(2) *Locations near exposures*: all outdoor ESS locations that do not comply with remote outdoor location requirements
(3) Specific outdoor locations, as follows:
    (1) *Rooftop installations*: ESS installations located on the roofs of buildings
    (2) *Open parking garage installations*: ESS installations located in a structure or portion of a structure as defined in 3.3.19
    (3) Mobile ESS installations

N **9.4 Installation.**

N **9.4.1 Maximum Stored Energy.** ESS in the following locations shall comply with Section 9.4 as follows:

(1) Fire areas within non-dedicated-use buildings containing ESS shall not exceed the maximum stored energy values in Table 9.4.1 except as permitted by 9.4.1.1.
(2) Outdoor ESS installations in locations near exposures shall not exceed the maximum stored energy values in Table 9.4.1 except as permitted by 9.4.1.2.
(3) ESS installations in open parking garages and on rooftops of buildings shall not exceed the maximum stored energy values in Table 9.4.1 except as permitted by 9.4.1.2.

(4) Mobile ESS equipment as covered by 9.5.3.2 shall not exceed the maximum stored energy values in Table 9.4.1 except as permitted by 9.4.1.2.

N 9.4.1.1 Where approved by the AHJ, fire areas in non-dedicated-use buildings containing ESS that exceed the amounts in Table 9.4.1 shall be permitted based on a hazard mitigation analysis in accordance with Section 4.4 and fire and explosion testing complying with 9.1.5.

N 9.4.1.2 Where approved by the AHJ, outdoor ESS installations, ESS installations in open parking garages and on rooftops of buildings, and mobile ESS equipment that exceed the amounts in Table 9.4.1 shall be permitted based on a hazard mitigation analysis in accordance with Section 4.4 and fire and explosion testing in accordance with 9.1.5.

N 9.4.1.3 Where a single fire area within a building or walk-in unit contains a combination of energy systems covered in Table 9.4.1, the maximum stored energy per fire area shall be determined based on the sum of percentages of each type divided by the maximum stored energy of each type.

N 9.4.1.4 The sum of the percentages calculated in 9.4.1.3 shall not exceed 100 percent except as permitted in 9.4.1.1 or 9.6.2.3.

N 9.4.2* Size and Separation.

N 9.4.2.1 ESS shall be comprised of groups with a maximum stored energy of 50 kWh each.

N 9.4.2.2 Each group shall be spaced a minimum 3 ft (0.9 m) from other groups and from walls in the storage room or area.

N 9.4.2.3 The AHJ shall be permitted to approve groups with larger energy capacities or smaller group spacing based on performance criteria from fire and explosion testing complying with 9.1.5.

N 9.4.2.4 Lead-Acid and Nickel-Cadmium Battery Systems.

N 9.4.2.4.1* Paragraphs 9.4.2.1 and 9.4.2.2 shall not apply to lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc in telecommunications facilities that comply with NFPA 76.

N Table 9.4.1 Maximum Stored Energy

ESS Type	Maximum Stored Energy[a] (kWh)
Lead-acid batteries, all types	Unlimited
Nickel batteries[b]	Unlimited
Lithium-ion batteries, all types	600
Sodium nickel chloride batteries	600
Flow batteries[c]	600
Other battery technologies	200
Storage capacitors	20

[a]For ratings in amp-hrs, kWh should equal maximum rated voltage multiplied by amp-hr rating divided by 1000.
[b]Nickel battery technologies include nickel cadmium (Ni-Cad), nickel metal hydride (Ni-MH), and nickel zinc (Ni-Zn).
[c]Includes vanadium, zinc-bromine, polysulfide, bromide, and other flowing electrolyte-type technologies.

N 9.4.2.4.2* Paragraphs 9.4.2.1 and 9.4.2.2 shall not apply to lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations.

N 9.4.2.4.3 Paragraphs 9.4.2.1 and 9.4.2.2 shall not apply to lead-acid battery systems in uninterruptable power supplies listed and labeled in accordance with UL 1778, utilized for standby power applications, which is limited to not more than 10 percent of the floor area on the floor on which the ESS is located.

N 9.4.2.4.4 Lead-acid and nickel-cadmium batteries listed to UL 1973 and used in stationary standby applications shall be comprised of groups with a maximum stored energy of 250 kWh each.

N 9.5 Location and Applications.

N 9.5.1 Indoor Installations. Indoor ESS installations shall comply with this section and as detailed in Table 9.5.1.

N 9.5.1.1 ESS Dedicated Use Buildings.

N 9.5.1.1.1 Where approved by the AHJ, the fire control and suppression systems, the size and separation requirements, and the water supply shall be permitted to be omitted in ESS dedicated-use buildings located more than 100 ft (30.5 m) from buildings, lot lines that can be built upon, public ways, stored combustible materials, hazardous materials, high-piled stock, and other exposure hazards not associated with electrical grid infrastructure.

N 9.5.1.1.2 When approved, alarm signals shall not be required to be transmitted to an approved location when local fire alarm annunciation is provided and trained personnel are always present.

N Table 9.5.1 Indoor ESS Installations

Compliance Required	ESS Dedicated-Use Buildings	Non-Dedicated-Use Buildings	Reference
Administrative	Yes	Yes	Chapters 1–3
General	Yes	Yes	Sections 4.1–4.7
Size and separation	Yes	Yes	9.4.2
Maximum stored energy	No	Yes	9.4.1
Elevation	Yes	Yes	4.7.7
Fire barriers	NA	Yes	9.6.4
Smoke and fire detection	Yes	Yes	9.6.1
Fire control and suppression	Yes	Yes	9.6.2
Water supply	Yes	Yes	9.6.3
Signage	Yes	Yes	4.7.4
Occupied work centers	Not allowed	Yes	9.5.1.2.1
Technology-specific protection	Yes	Yes	9.6.5

NA: Not applicable.

N **9.5.1.2 Non-Dedicated-Use Buildings.**

N **9.5.1.2.1* Occupied Work Centers.** ESS in occupied work centers shall comply with this section.

N **9.5.1.2.1.1** ESS shall be permitted in the same room as the equipment that they support.

N **9.5.1.2.1.2** ESS shall be housed in a noncombustible, locked cabinet or other enclosure to prevent access by unauthorized personnel unless located in an equipment room accessible only to authorized personnel.

N **9.5.1.2.2 Dwelling Units and Sleeping Units.**

N **9.5.1.2.2.1** Stationary ESS shall not be installed in sleeping rooms or closets or spaces opening directly into sleeping rooms.

N **9.5.1.2.2.2** Stationary ESS shall not be installed in living areas of dwelling units unless specifically allowed in Chapters 9 through 13.

N **9.5.1.2.2.3** Portable ESS shall be permitted to be used in sleeping rooms and in habitable spaces of dwelling units provided they are listed and are used in accordance with the terms of their listing.

N **9.5.2 Outdoor Installations.** Outdoor ESS installations shall comply with this section and as detailed in Table 9.5.2.

N **9.5.2.1 HMA.** A HMA shall be required for lithium-ion ESS that exceed 600 kWh (2,160 MJ) for outdoor ESS installations, ESS installations in open parking garages and on rooftops of buildings, and mobile ESS equipment.

N **9.5.2.2 Vegetation Control.**

N **9.5.2.2.1** Areas within 10 ft (3 m) on each side of outdoor ESS shall be cleared of combustible vegetation and other combustible growth.

N **9.5.2.2.2** Single specimens of trees, shrubbery, or cultivated ground cover such as green grass, ivy, succulents, or similar plants used as ground covers shall be permitted to be exempt provided that they do not form a means of readily transmitting fire.

N **9.5.2.3 Walk-in Units.**

N **9.5.2.3.1** Where an ESS includes an outer enclosure, the unit shall only be entered for inspection, maintenance, and repair of energy storage units and ancillary equipment and not be occupied for other purposes.

N **9.5.2.3.2*** Walk-in units shall comply with this standard and local building code requirements.

N **9.5.2.3.3** Spacing shall not be required between the ESS and the enclosure walls in outdoor walk-in units.

N **9.5.2.4 Maximum Size.**

N **9.5.2.4.1** Outdoor ESS walk-in units or ESS cabinets shall not exceed 53 ft × 8.5 ft × 9.5 ft (16.2 m × 2.6 m × 2.9 m), not including HVAC and other equipment.

N **9.5.2.4.2** Outdoor ESS walk-in units or ESS cabinets that exceed the dimensions in 9.5.2.4.1 shall be treated as indoor installations and comply with the requirements in 9.5.1.

N **9.5.2.5 Remote Locations.** When agreeable with the ESS owner and approved by the AHJ, fire suppression systems and water supply shall not be required.

N **9.5.2.6 Locations Near Exposures.**

N **9.5.2.6.1 Clearance to Exposures.** ESS located outdoors shall be separated by a minimum 10 ft (3 m) from the following exposures:

(1) Lot lines
(2) Public ways
(3) Buildings
(4) Stored combustible materials
(5) Hazardous materials
(6) High-piled stock
(7) Other exposure hazards not associated with electrical grid infrastructure

N **9.5.2.6.1.1** The required separation distances shall be permitted to be reduced to 3 ft (0.9 m) when a 1-hour freestanding fire barrier, suitable for exterior use, and extending 5 ft (1.5 m) above and 5 ft (1.5 m) beyond the physical boundary of the ESS installation is provided to protect the exposure.

N **9.5.2.6.1.2** Clearances to buildings shall be permitted to be reduced to 3 ft (0.9 m) where noncombustible exterior walls with no openings or combustible overhangs are provided on the wall adjacent to the ESS and the fire resistance rating of the exterior wall complies with the fire resistance requirements in 9.6.4.

N **9.5.2.6.1.3** Clearances to buildings shall be permitted to be reduced to 3 ft (0.9 m) based on fire and explosion testing complying with 9.1.5.

N **Table 9.5.2 Outdoor Stationary ESS Installations**

Compliance Required	Remote Locations	Locations Near Exposures	Reference
Administrative	Yes	Yes	Chapters 1–3
General	Yes	Yes	Sections 4.1–4.7
Maximum size	Yes	Yes	9.5.2.4
Clearance to exposures	NA	Yes	9.5.2.6.1
Means of egress separation	NA	Yes	9.5.2.6.1.7
Walk-in units	Yes	Yes	9.5.2.3
Vegetation control	Yes	Yes	9.5.2.2
Enclosures	Yes	Yes	4.6.12
Size and separation	No	Yes	9.4.2
Maximum stored energy	No	Yes	9.4.1
Smoke and fire detection	Yes	Yes	9.6.1
Fire control and suppression	Yes	Yes	9.6.2
Water supply	Yes	Yes	9.6.3
Signage	Yes	Yes	4.7.4
Occupied work centers	Not allowed	Not allowed	9.5.1.2.1
Technology-specific protection	Yes	Yes	9.6.5

NA: Not applicable.

N 9.5.2.6.1.4 Where approved, clearances to exposures other than buildings shall be permitted to be reduced to 3 ft (0.9 m) where fire and explosion testing of the ESS in accordance with 9.1.5 demonstrates that a fire within the ESS enclosure will not generate radiant heat flux sufficient to ignite stored materials or otherwise threaten the exposure.

N 9.5.2.6.1.5 Clearances to buildings and exposures shall be permitted to be reduced to 3 ft (0.9 m) where the enclosure of the ESS has a 2-hour fire resistance rating established in accordance with ASTM E119 or UL 263.

N 9.5.2.6.1.6 **ESS Exhaust Outlets.** ESS exhaust outlets shall comply with the following:

(1) Exhaust outlets from an ESS that exhaust other than ventilation air shall be located at least 15 ft (4.57 m) from heating, ventilating, and air conditioning (HVAC) air intakes, windows, doors, loading docks, ignition sources, and other openings into buildings and facilities.
(2) Exhaust outlet(s) from an ESS shall not be directed onto means of egress, walkways, or pedestrian or vehicular travel paths.

N 9.5.2.6.1.7 **Means of Egress Separation.**

N (A) ESS located outdoors shall be separated from any accessible means of egress as required by the AHJ to ensure safe egress under fire conditions but in no case less than 10 ft (3 m).

N (B) Where approved by the AHJ, clearances to accessible means of egress shall be permitted to be reduced to 3 ft (0.9 m) where fire and explosion testing in accordance with 9.1.5 demonstrates that a fire within the ESS will not adversely impact the means of egress.

N 9.5.2.6.1.8 **Exterior Wall Installations.**

N (A) ESS shall be permitted to be installed outdoors on exterior walls of buildings when all of the following conditions are met:

(1) The maximum stored energy of individual ESS units shall not exceed 20 kWh (72 MJ).
(2) The ESS shall comply with applicable requirements in Chapter 4.
(3) The ESS shall be installed in accordance with the manufacturer's instructions and their listing.
(4) Individual ESS units shall be separated from each other by at least 3 ft (0.9 m).
(5) The ESS shall be separated from doors, windows, operable openings into buildings, or HVAC inlets by at least 5 ft (1.5 m).

N (B) Where approved by the AHJ, smaller separation distances in 9.5.2.6.1.8(A)(4) and 9.5.2.6.1.8(A)(5) shall be permitted based on fire and explosion testing in accordance with 9.1.5.

N 9.5.3 **Specific Outdoor Locations.**

N 9.5.3.1 **Rooftop and Open Parking Garage Installations.** Rooftop and open parking garage ESS installations shall comply with this section and as detailed in Table 9.5.3.1.

N 9.5.3.1.1 **Rooftop Installations.**

N 9.5.3.1.1.1 Installations shall be permitted on rooftops of buildings that do not obstruct fire department rooftop operations when approved.

N **Table 9.5.3.1 Rooftop and Open Parking Garage ESS Installations**

Compliance Required	Rooftops	Open Parking Garages	Reference
Administrative	Yes	Yes	Chapters 1–3
General	Yes	Yes	Sections 4.1–4.7
Maximum size	Yes	Yes	9.5.2.4
Means of egress separation	Yes	Yes	9.5.2.6.1.7
Walk-in units	Yes	Yes	9.5.2.3
Enclosures	Yes	Yes	4.6.12
Clearance to exposures	Yes	Yes	9.5.3.1.3
Fire suppression and control	Yes	Yes	9.5.3.1.4
Size and separation	Yes	Yes	9.4.2
Maximum stored energy	Yes	Yes	9.4.1
Elevation	Yes	Yes	4.7.7
Smoke and fire detection	Yes	Yes	9.6.1
Signage	Yes	Yes	4.7.4
Occupied work centers	Not allowed	Not allowed	9.5.1.2.1
Open rack installations	Not allowed	Not allowed	4.7.9
Technology-specific protection	Yes	Yes	9.6.5

NA: Not applicable.

N 9.5.3.1.1.2 ESS comprised of units with a maximum stored energy greater than 20 kWh, and associated equipment, that are located on rooftops and not enclosed by building construction shall comply with the following:

(1) The roofing materials under and within 5 ft (1.5 m) horizontally from an ESS or associated equipment shall comply with one of the following:
   (a) Be noncombustible
   (b) Have a Class A rating when tested in accordance with ASTM E108 or UL 790
(2) ESS and associated equipment shall be located from the edge of the roof a distance equal to at least the height of the system, equipment, or component but not less than 5 ft (1.5 m).
(3) Installations on rooftops over 75 ft (23 m) in height above grade shall be permitted where approved by the AHJ.
(4) The ESS shall be a minimum of 10 ft (3 m) from the fire service access point on the rooftop.
(5) Stairway access to the roof for emergency response and fire department personnel shall be provided either through a bulkhead from the interior of the building or a stairway on the exterior of the building.
(6) Access, service space, guards, and handrails shall be provided where required by the local building and mechanical codes.
(7) Service walkways at least 5 ft (1.5 m) in width shall be provided for service and emergency personnel from the point of access to the roof to the system.

(8) A Class I standpipe outlet shall be installed at an approved location on the roof level of the building or in the stairway bulkhead at the top level.
(9) A radiant-energy-sensing fire detection system complying with Section 4.8 shall be provided to protect the ESS.

N **9.5.3.1.1.3** Individual ESS units with a maximum stored energy of 20 kWh or less that are located on rooftops shall comply with all of the following:

(1) The systems shall be listed in accordance with 4.6.1.
(2) The systems shall comply with 9.5.3.1.1.2(1) through 9.5.3.1.1.2(4).
(3)* The systems shall comply with the fire and explosion testing requirements in its intended installation configuration.
(4) The ESS unit shall meet the unit level fire performance requirements of indoor residential units as identified in UL 9540A.
(5) Each ESS unit shall be spaced a minimum of 3 ft (0.9m) from other units, except as provided in 9.5.3.1.1.3(6).
(6) The AHJ shall be permitted to approve a smaller distance based on performance criteria from fire and explosion testing complying with 9.1.5.

N **9.5.3.1.2 Open Parking Garages.** ESS and associated equipment that are located in open parking garages shall comply with all of the following:

(1) ESS shall not be located within 50 ft (15.3 m) of air inlets for building HVAC systems. When approved, this distance is permitted to be reduced to 25 ft (7.6 m) if the automatic fire alarm system monitoring the radiant energy-sensing detectors de-energizes the ventilation system connected to the air intakes upon detection of fire.
(2) ESS shall not be located within 25 ft (7.6 m) of exits leading from the attached building when located on a covered level of the parking structure not directly open to the sky above. When approved, the separation distance is permitted to be reduced to 10 ft (3 m) based on fire, explosion, and fault condition testing conducted in accordance with 9.1.5.
(3) Means of egress separation shall comply with 9.5.2.6.1.7.
(4) A radiant energy-sensing fire detection system complying with Section 4.8 shall be provided to protect the ESS.
(5) An approved fence with a locked gate or other approved barrier shall be provided to keep the general public at least 5 ft (1.5 m) from the outer enclosure of the ESS.

N **9.5.3.1.3 Clearance to Exposures.**

N **9.5.3.1.3.1** ESS located on rooftops and in open parking garages shall be separated by a minimum 10 ft (3 m) from the following exposures:

(1) Buildings, except the portion of the building on which rooftop ESS is mounted
(2) Lot lines
(3) Public ways
(4) Stored combustible materials
(5) Locations where motor vehicles can be parked
(6) Hazardous materials
(7) Other exposure hazards

N **9.5.3.1.3.2** Clearances shall be permitted to be reduced to 3 ft (0.9 m) under the following conditions:

(1) Where a 1-hour freestanding fire barrier, suitable for exterior use, and extending 5 ft (1.5 m) above and extending 5 ft (1.5 m) beyond the physical boundary of the ESS installation is provided to protect the exposure
(2) Where the weatherproof ESS enclosure is constructed of noncombustible materials and it has been demonstrated that a fire within the enclosure will not ignite combustible materials outside the enclosure based on fire and explosion testing complying with 9.1.5

N **9.5.3.1.4 Fire Suppression and Control.**

N **9.5.3.1.4.1** ESS located in walk-in enclosures on rooftops or in open parking garages shall be provided with automatic fire control and suppression systems within the ESS enclosure in accordance with Section 4.9.

N **9.5.3.1.4.2** Areas containing ESS other than walk-in units in open parking structures not open above to the sky shall be provided with an automatic fire suppression system complying with Section 4.9.

N **9.5.3.1.4.3** When approved by the AHJ, ESS shall be permitted to be installed in open parking garages without the protection of an automatic fire control and suppression system where fire and explosion testing conducted in accordance with 9.1.5 indicates that an ESS fire does not present an exposure hazard to parked vehicles or compromise the means of egress.

N **9.5.3.2 Mobile ESS Equipment and Operations.** Mobile ESS operation shall be classified as specified in 9.5.3.2.1 or 9.5.3.2.2.

N **9.5.3.2.1 Charging and Storage.**

N **9.5.3.2.1.1** For the purpose of 9.5.3.2, charging and storage shall cover the operation where mobile ESS are charged and stored so they are ready for deployment to another site and where they are charged and stored after a deployment.

N **9.5.3.2.1.2** Mobile ESS used to temporarily provide power to lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations shall not be required to comply with 9.5.3.2.1.

N **9.5.3.2.2 Deployment.**

N **9.5.3.2.2.1** For the purpose of 9.5.3.2, deployment shall cover operations where mobile ESS are located at a site other than the charging and storage site and are being used to provide power.

N **9.5.3.2.2.2** Mobile ESS used to temporarily provide power to lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations shall not be required to comply with 9.5.3.2.2.

N **9.5.3.2.3 Approved Locations.** Locations where mobile ESS are charged, stored, and deployed shall be restricted to the locations approved by the AHJ.

N **9.5.3.2.4 Local Staging.** Mobile ESS in transit from the charging and storage location to the deployment location and back shall not be parked within 100 ft (30.5 m) of an occupied building for more than 1 hour during transit, unless specifically approved in advance by the AHJ.

N **9.5.3.2.5 Charging and Storage Requirements.** Installations where mobile ESS are charged and stored shall be treated as permanent ESS installations and shall comply with the following sections, as applicable:

(1) Indoor charging and storage shall comply with 9.5.2.4.1.
(2) Outdoor charging and storage shall comply with 9.5.2.
(3) Charging and storage on rooftops and in open parking garages shall comply with 9.5.3.1.

N **9.5.3.2.5.1** Construction documents complying with Section 4.2 shall be provided to the AHJ with any locally required construction permit applications for mobile ESS charging and storage locations.

N **9.5.3.2.5.2** Electrical connections shall be permitted to be made using temporary wiring complying with the manufacturer's instructions, the UL 9540 listing, and *NFPA 70*.

N **9.5.3.2.5.3** Fire suppression system connections to the water supply shall be acceptable to the AHJ.

N **9.5.3.2.6 Deployed Mobile ESS Requirements.** Deployed mobile ESS equipment and operations shall comply with this section and Table 9.5.3.2.6.

N **9.5.3.2.6.1 Deployment Documents.** The following information shall be provided to the AHJ with any locally required operational permit applications for mobile ESS deployments:

(1) Relevant information for the mobile ESS equipment and protection measures in the construction documents required by Section 4.2
(2) Location and layout diagram of the area in which the mobile ESS is to be deployed, including a scale diagram of all nearby exposures
(3) Location and content of signage
(4) Description of fencing to be provided around the ESS, including locking methods
(5) Details on fire suppression, smoke and automatic fire detection, system monitoring, thermal management, exhaust ventilation, and explosion control, if provided
(6) For deployment, the intended duration of operation, including anticipated connection and disconnection times and dates
(7) Description of the temporary wiring, including connection methods, conductor type and size, and circuit overcurrent protection to be provided
(8) Description of how fire suppression system connections to water supplies or extinguishing agents are to be provided
(9) Contact information for personnel who are responsible for maintaining and servicing the equipment and responding to emergencies

N **Table 9.5.3.2.6 Mobile Energy Storage Systems (ESS)**

Compliance Required	Deployment	Reference
Administrative	Yes	Chapters 1–3
General	Yes	Sections 4.1–4.7
Size and separation	Yes[a]	9.4.2
Maximum stored energy	Yes	9.4.1
Fire and smoke detection	Yes[b]	9.6.1
Fire control and suppression	Yes[c]	9.6.2
Maximum size	Yes	9.5.2.4
Vegetation control	Yes	9.5.2.2
Means of egress separation	Yes	9.5.2.6.1.7
Technology-specific protection	Yes	9.6.5

[a]In walk-in units, spacing is not required between ESS units and the walls of the enclosure.
[b]Alarm signals are not required to be transmitted to an approved location for mobile ESS deployed 30 days or less.
[c]Only required for walk-in units.

N **9.5.3.2.6.2 Restricted Locations.** Deployed mobile ESS operations shall not be located indoors, in covered parking garages, on rooftops, below grade, or under building overhangs.

N **9.5.3.2.6.3 Wheeled Vehicles.** Mobile operations on wheeled vehicles or trailers shall not be required to comply with 4.7.2 seismic protection requirements.

N **9.5.3.2.6.4 Fire Suppression Connections.** Fire suppression system connections to the water supply shall be permitted to use approved temporary connections.

N **9.5.3.2.6.5 Duration.**

N **(A)** Mobile ESS deployments that provide power for durations longer than 30 days shall comply with 9.5.3.2.5.

N **(B)** Mobile ESS deployments in excess of 30 days, for emergencies, shall not be required to comply with 9.5.3.2.5, with AHJ approval.

N **9.5.3.2.6.6 Clearance to Exposures.**

N **(A)** Deployed mobile ESS shall be separated by a minimum 10 ft (3 m) from the following exposures:

(1) Public ways
(2) Buildings
(3) Stored combustible materials
(4) Hazardous materials
(5) High-piled stock
(6) Other exposure hazards not associated with electrical grid infrastructure

N **(B)** Required separation distances shall be permitted to be reduced in accordance with 9.5.2.6.1.1 through 9.5.2.6.1.4.

N **(C)** Deployed mobile ESS shall be separated by a minimum 50 ft (15.3 m) from public seating areas and from tents, canopies, and membrane structures with an occupant load of 30 or more.

N **9.5.3.2.6.7 Electrical Connections.** Electrical connections shall be made in accordance with the manufacturer's instructions.

N **(A)** Temporary wiring for electrical power connections shall comply with *NFPA 70* or equivalent code.

N **(B)** Fixed electrical wiring shall not be permitted.

N **9.5.3.2.6.8 Fencing.**

N **(A)** An approved fence with a locked gate or other approved barrier shall be provided to keep the general public at least 5 ft (1024 mm) from the outer enclosure of a deployed mobile ESS.

N **(B)** A mobile ESS that is locked to prevent access by unauthorized persons shall be permitted to comply with 9.5.3.2.6.8(A).

N **9.6 Protection and Remediation.**

N **9.6.1 Smoke and Fire Detection.** Areas containing ESS systems located within buildings or structures shall be provided with a smoke detection or radiant energy–sensing system in accordance with Section 4.8, unless modified by this chapter.

N **9.6.2 Fire Control and Suppression.**

N **9.6.2.1** Fire control and suppression for rooms or areas within buildings and outdoor walk-in units containing ESS shall be provided in accordance with Section 4.9, unless modified by this chapter.

N **9.6.2.2 Lead-Acid and Nickel-Cadmium Battery Systems.**

N **9.6.2.2.1** Lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc that are in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces used exclusively for such installations that comply with NFPA 76 shall not be required to have a fire suppression system installed.

N **9.6.2.2.2** Lead-acid battery systems in uninterruptable power supplies listed and labeled in accordance with the application used for standby power applications, which is limited to not more than 10 percent of the floor area on the floor on which the ESS is located, shall not be required to have a fire suppression system installed.

N **9.6.2.2.3*** Lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations shall not be required to have a fire suppression system installed.

N **9.6.2.3** Where more than one ESS technology is present within a fire area, the fire protection systems shall be designed to protect the greatest hazard.

N **9.6.3 Water Supply.**

N **9.6.3.1** Sites where nonmechanical ESS are installed shall be provided with a permanent source of water for fire protection in accordance with 4.9.4, unless modified by this chapter.

N **9.6.3.2 Lead-Acid and Nickel-Cadmium Systems.**

N **9.6.3.2.1*** Normally unoccupied, remote standalone telecommunications structures with a gross floor area of less than 1500 ft^2 (139 m^2) with lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc that are in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces used exclusively for such installations that comply with NFPA 76 shall not be required to have a fire water supply.

N **9.6.3.2.2** Lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations shall not be required to have a fire water supply.

N **9.6.4 Fire Barriers.** Rooms or spaces containing ESS shall be separated from other areas of the building by fire barriers with a minimum 2-hour fire resistance rating and horizontal assemblies with a minimum 2-hour fire resistance rating, constructed in accordance with the local building code.

N **9.6.4.1** Rooms or spaces, containing only ESS listed to UL 9540 and that are marked as meeting the cell-level performance criteria of UL 9540A, shall be permitted to be separated from other areas of the building with a minimum 1-hour fire resistance rating constructed in accordance with local building codes.

N **9.6.4.2** Lead-acid and nickel cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations shall not be required have a 2-hour fire resistance separation from the rest of the building.

9.6.5 Technology-Specific Requirements. Electrochemical ESS shall comply with the applicable sections of Chapters 4 and 9 as specified in Table 9.6.5.

N **9.6.5.1* Exhaust Ventilation During Normal Operation.** Where required by Table 9.6.5 or elsewhere in this standard, exhaust ventilation during normal operation shall be provided for rooms, enclosures, walk-in units, and cabinets as follows:

(1) ESS rooms and walk-in units shall use mechanical exhaust ventilation in accordance with 9.6.5.1.5.

Δ Table 9.6.5 Electrochemical ESS Technology-Specific Requirements

Compliance Required	Battery Technology						Other Electrochemical ESS and Battery Technologies*	Reference
	Lead-Acid	Ni-Cd, Ni-MH, Ni-Zn	Lithium-Ion	Flow	Sodium Nickel Chloride	EDLC Energy Storage		
Exhaust ventilation	Yes	Yes	No	Yes	No	Yes	Yes	9.6.5.1
Spill control	Yes †	Yes †	No	Yes	No	Yes	Yes	9.6.5.2
Neutralization	Yes†	Yes†	No	Yes	No	Yes	Yes	9.6.5.3
Safety caps	Yes	Yes	No	No	No	Yes	Yes	9.6.5.4
Thermal runaway	Yes	Yes	Yes	No	Yes	Yes	Yes	9.6.5.5
Explosion control	Yes	Yes	Yes	No	Yes	Yes	Yes	9.6.5.6

*The protection in this column is not required if documentation acceptable to the AHJ, including a hazard mitigation analysis complying with Section 4.4, provides justification that the protection is not necessary based on the technology used.
†Applicable only to vented (e.g., flooded) batteries.

(2) Outdoor ESS cabinets shall use either mechanical or natural exhaust ventilation in accordance with 9.6.5.1.4 or 9.6.5.1.5.

N **9.6.5.1.1 Ni-MH Batteries.** Exhaust ventilation shall not be required for Ni-MH batteries.

N **9.6.5.1.2 Abnormal Conditions.** Protection against the release of flammable gases during abnormal charging or thermal runaway conditions shall be in accordance with 9.6.5.6.

N **9.6.5.1.3 Indoor ESS Cabinets.** Exhaust ventilation for ESS cabinets installed indoors shall evaluate air movement through the cabinet and exhaust from the room.

N **9.6.5.1.4* Natural Exhaust Ventilation.** Exhaust ventilation shall be designed to limit the maximum concentration of flammable gas to 25 percent of the lower flammable limit (LFL) of the total volume of the outdoor cabinet during the worst-case event of simultaneous "boost" charging of all the batteries, in accordance with nationally recognized standards.

N **9.6.5.1.5 Mechanical Exhaust Ventilation.** Exhaust ventilation shall be provided in accordance with the applicable mechanical code and one of the following:

(1) Where hydrogen is the gas generated, an exhaust ventilation rate based on hydrogen generation estimates sufficient to limit the maximum concentration of hydrogen to 1.0 percent of the total volume of the room, walk-in unit, or cabinet during the worst-case event of simultaneous "boost" charging of all the batteries, in accordance with nationally recognized standards

(2) An exhaust ventilation rate based on the area of not less than 1 $ft^3/min/ft^2$ (5.1 $L/sec/m^2$) of floor area of the room, walk-in unit, enclosure, container, or cabinet

N **9.6.5.1.5.1** Mechanical exhaust ventilation shall be either continuous or activated by a gas detection system in accordance with 9.6.5.1.5.4.

N **9.6.5.1.5.2** Required mechanical exhaust ventilation systems shall be installed in accordance with the manufacturer's installation instructions and local building, mechanical, and fire codes.

N **9.6.5.1.5.3** Required mechanical exhaust ventilation systems shall either be supervised by an approved central, proprietary, or remote station service in accordance with *NFPA 72* or initiate an audible and visual signal at an approved, constantly attended location.

N **9.6.5.1.5.4*** Where gas detection is used to activate exhaust ventilation in accordance with 9.6.5.1.5.1, rooms, walk-in units, enclosures, walk-in containers, and cabinets containing ESS shall be protected by an approved continuous gas detection system that complies with the following:

(1) The gas detection system shall be designed to activate the mechanical exhaust ventilation system when the level of flammable gas detected in the room, walk-in unit, enclosure, container, and cabinet exceeds 25 percent of the LFL of the flammable gas mixture.

(2) The mechanical exhaust ventilation system shall remain on until the flammable gas detected is less than 25 percent of the LFL of the flammable gas mixture.

(3) The gas detection system shall be provided with a minimum of 2 hours of standby power.

(4) Failure of the gas detection system shall annunciate a trouble signal at an approved central, proprietary, or remote station in accordance with *NFPA 72* or at an approved, constantly attended location.

N **9.6.5.2 Spill Control.**

N **9.6.5.2.1** Rooms, buildings, or areas containing ESS with free-flowing liquid electrolyte in individual vessels having a capacity of more than 55 gal (208 L) or multiple vessels having an aggregate capacity exceeding 1000 gal (3785 L) shall be provided with spill control to prevent the flow of liquids to adjoining areas.

N **9.6.5.2.2*** An approved method and materials for the control of a spill of electrolyte or other hazardous liquid shall be provided that will be capable of controlling a spill from the single largest vessel.

N **9.6.5.2.3** In rooms, buildings, or areas protected by water-based fire protection systems, the capacity of the spill containment system shall accommodate the capacity of the expected fire protection system discharge for a period of 10 minutes.

N **9.6.5.2.4** The capacity increase in 9.6.5.2.3 shall not apply to integral spill containment systems that are shielded from the fire protection system discharge.

N **9.6.5.2.5** Sealed valve-regulated lead-acid (VRLA) batteries and other ESS equipment with immobilized electrolyte and immobilized hazardous liquids shall not require spill control.

N **9.6.5.2.6** Rooms, buildings, or areas containing other hazardous materials shall include spill control as required in NFPA 1.

N **9.6.5.3 Neutralization.**

N **9.6.5.3.1*** An approved method to neutralize spills from ESS with free-flowing electrolyte shall be provided.

N **9.6.5.3.2** Neutralization shall not be required for ESS with immobilized electrolyte.

N **9.6.5.3.3** The method shall be capable of neutralizing a spill from the largest battery or vessel to a pH between 5.0 and 9.0.

9.6.5.4* Safety Caps. Where required by Table 9.6.5, vented batteries used in ESS shall be provided with flame-arresting safety caps.

9.6.5.5* Thermal Runaway Protection. Where required by Table 9.6.5, a listed device evaluated as part of the ESS or other approved method shall be provided to manage charging and discharging during normal operation of the ESS to maintain batteries and capacitors within their safe operating parameters and preclude thermal runaway.

N **9.6.5.5.1** Thermal runaway protection shall not be required for vented (e.g., flooded) lead-acid and Ni-Cd batteries.

N **9.6.5.5.2** Thermal runaway protection shall be permitted to be provided by the battery management system or a capacitor ESS management system that has been evaluated as part of the UL 1973 or UL 9540 listing.

N **9.6.5.6* Explosion Control.**

N **9.6.5.6.1** Where required elsewhere in this standard, explosion prevention or deflagration venting shall be provided in accordance with this section.

N **9.6.5.6.1.1** Explosion prevention and deflagration venting shall not be required where approved by the AHJ based on fire and explosion testing in accordance with 9.1.5 and a deflagration hazard study demonstrating that flammable gas concentrations cannot exceed 25 percent of the LFL.

N **9.6.5.6.1.2** Explosion control shall not be required for the following:

(1) Lead-acid and Ni-Cd battery systems less than 50 V ac, 60 V dc in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities located in building spaces or walk-in units used exclusively for such installations that comply with NFPA 76
(2) Lead-acid and Ni-Cd battery systems that are and used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility located outdoors or in building spaces used exclusively for such installations
(3) Lead-acid battery systems in uninterruptable power supplies listed and labeled in accordance with the application used for standby power applications, and housed in a single cabinet in a single fire area in buildings or walk-in units
(4) Lead-acid and Ni-Cd batteries listed in accordance with UL 1973
(5) Batteries listed in accordance with UL 1973 that do not go into thermal runaway or produce flammable gas in the UL 9540A cell level test or equivalent test

N **9.6.5.6.2** Protection against the release of flammable gases during normal operation shall be in accordance with 9.6.5.1.

N **9.6.5.6.3*** ESS installed within a room, building, ESS cabinet, ESS walk-in unit, or otherwise nonoccupiable enclosure shall be provided with one of the following:

(1) Explosion prevention systems designed, installed, operated, maintained, and tested in accordance with NFPA 69
(2) Deflagration venting installed and maintained in accordance with NFPA 68

N **9.6.5.6.4*** Where approved, ESS cabinets designed to ensure that no hazardous pressure waves, debris, shrapnel, or enclosure pieces are ejected, as validated by installation level fire and explosion testing and an engineering evaluation complying with 9.1.5 that includes the cabinet, shall be permitted in lieu of providing explosion control that complies with NFPA 68 or NFPA 69.

N **9.6.5.6.5** ESS enclosures and cabinets shall be designed so explosive discharge of gases or projectiles are not ejected during fire and explosion testing complying with 9.1.5 that includes the ESS enclosure and cabinets.

N **9.6.5.6.6*** Where ESS batteries or cabinets are installed in a container outdoors, other than a walk-in unit, the installation shall comply with one of the following:

(1) The container shall be provided with explosion control complying with 9.6.5.6.3.
(2) Combination of the container and cabinets shall be tested together to show compliance with 9.6.5.6.1.1.

N **9.6.5.6.7** Where gas detection is used to activate a combustible gas concentration reduction system and based on an appropriate NFPA 69 deflagration study, enclosures containing ESS shall be protected by an approved continuous gas detection system that complies with the following:

(1) The gas detection system shall be designed to activate the combustible gas concentration reduction system on detection of flammable gases at no more than 10 percent of the LFL of the gas mixture or of the individual components.
(2) The combustible gas concentration reduction system shall remain on to ensure the flammable gas does not exceed 25 percent of the LFL of the gas mixture or of the individual components.
(3) The gas detection system and combustible gas concentration reduction system shall be provided with a minimum of 2 hours of standby power.
(4) For lithium-ion batteries, the gas detection system shall be provided with a minimum of 24 hours of standby power and 2 hours in alarm or as required by the HMA.
(5) The gas detection system shall annunciate the following at an approved central, proprietary, or remote station in accordance with *NFPA 72*, or at an approved constantly attended location:
    (a) A trouble signal upon failure of the gas detection system
    (b) An alarm signal if flammable gas concentration exceeds 10 percent of the LFL

N **9.6.5.6.8** Compartmentalization created by cold and hot aisle arrangements within the ESS enclosure shall be addressed in accordance with the following:

(1) For NFPA 69 designs, the performance of ventilation systems shall be independently verified for a thermal runaway event in either aisle/subcompartment.
(2) For NFPA 68 designs, the placement of explosion relief panels shall ensure that the explosion hazard is addressed for both hot and cold aisles/subcompartments.
(3) The gas detection system shall be designed to activate on detection of flammable gas in either aisle/subcompartment.

N **9.6.5.6.9** The protection design shall demonstrate that deflagrations are not propagated to interconnected or adjacent cabinets, enclosures, or rooms.

N **9.6.6 Remediation Measures.**

N **9.6.6.1* Authorized Service Personnel.** Where a fire or other event has damaged the ESS and ignition or reignition of the ESS is possible, the owner, agent, or lessee shall dispatch authorized service personnel to assist emergency first responders to mitigate the hazard or remove damaged equipment from the premises with a response time approved by the AHJ.

N **9.6.6.2* Hazard Support Personnel.** Where required by the AHJ for public safety, the owner or their authorized agent shall provide hazard support personnel at the owner's expense.

N **9.6.6.2.1*** Trained hazard support personnel shall be approved by the AHJ.

N **9.6.6.2.2** Trained hazard support personnel shall be available to respond to possible ignition or re-ignition of the damaged ESS, within the response time noted in the approved emergency operations plan.

N **9.6.6.2.3** The authorized service personnel shall be permitted to perform the duties of the hazard support personnel.

N **9.6.6.2.4*** Required hazard support personnel shall monitor the ESS continuously in a method approved by the AHJ from the time the fire department releases the emergency scene until the hazard is mitigated and the AHJ gives authorization to the owner or their authorized agent that onsite hazard support personnel are no longer required.

N **9.6.6.2.5*** On-duty hazard support personnel shall have the following responsibilities:

(1) Ensure the security and safety of the ESS site in accordance with the emergency operation plan and decommissioning plan
(2) Keep diligent watch for fires or signs of off-gassing, obstructions to means of egress, and other hazards for the time required in accordance with 9.6.6.2.4
(3) Ensure a means of communication is available to immediately contact the fire department if their assistance is needed to mitigate any hazards
(4) Take prompt measures for remediation of hazards
(5) Take prompt measures to assist in the evacuation of the public from the structures in accordance with the emergency operations plan
(6) Allow only authorized personnel to enter the ESS site
(7) Ensure authorized personnel are wearing proper PPE
(8) Where required by the AHJ, maintain a written or electronic log of all personnel entering/leaving the portion of the site containing the ESS
(9) Record all postincident tasks performed

Δ Chapter 10 (Reserved)

Chapter 11 Fuel Cell Energy Storage Systems

11.1 Installation and Maintenance.

Δ **11.1.1** Stationary fuel cell ESS shall comply with the following requirements of Chapter 4:

(1) Charge controllers *(see 4.6.8)*
(2) Inverters and converters *(see 4.6.9)*
(3) Energy storage management system (ESMS) *(see 4.6.10)*
(4) Impact protection *(see 4.7.5)*
(5) Smoke and fire detection *(see Section 4.8)*
(6) Fire control and suppression *(see Section 4.9)*
(7) Water supply *(see 4.9.4)*
(8) Signage *(see 4.7.4)*
(9) Combustible storage *(see Section 4.5)*
(10) Hazard mitigation analysis *(see Section 4.4)*
(11) Emergency planning and training *(see Section 4.3)*
(12) Construction documents *(see Section 4.2)*

11.1.2 Non-hydrogen-fueled stationary fuel cell ESS shall be installed and maintained in accordance with *NFPA 70*, NFPA 853, the manufacturer's instructions, and the equipment listing.

11.1.3 Hydrogen-fueled stationary fuel cell ESS shall be installed and maintained in accordance with NFPA 2, *NFPA 70*, NFPA 853, the manufacturer's instructions, and the equipment listing.

11.2 Fuel-Cell-Powered Vehicle Use.

11.2.1 The temporary use of the dwelling unit owner's or occupant's fuel-cell-powered vehicle to power the dwelling in a one- and two-family dwelling or townhouse unit while parked in an attached or detached garage or outside shall only be required to comply with the vehicle manufacturer's instructions and *NFPA 70*.

11.2.2 The temporary use of the dwelling unit owner's or occupant's fuel-cell-powered vehicle to power the dwelling in a one- and two-family dwelling or townhouse unit while parked in an attached or detached garage or outside shall not be for more than 30 days.

Chapter 12 Superconducting Magnet Energy Storage (Reserved)

Δ Chapter 13 Flywheel Energy Storage Systems (FESS)

N 13.1 Application.

N **13.1.1** The requirements of this chapter shall apply to the installation of flywheel ESS (FESS).

N **13.1.2*** This chapter shall not apply to FESS for electric utilities under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations.

N **13.1.3*** FESS shall not be installed in individual one- or two-family dwellings or in townhouse units.

N **13.2 Protection Features.** FESS installations shall comply with the requirements of Chapters 4 through 8, except as specified in Table 13.2.

N **13.2.1** The construction documents required by 4.2.1.1 shall apply to FESS except for 4.2.1.1(2) and 4.2.1.1(7).

N **13.2.2** The requirements in 4.3.2.1.4 for the emergency operations plan shall apply except for 4.3.2.1.4(5) and 4.3.2.1.4(6).

N **13.2.3** A hazard mitigation analysis shall only be required for FESS in accordance with 4.4.1(2).

N **13.2.4** FESS shall be listed in accordance with UL 9540.

N **13.2.5*** FESS shall not be installed in locations that could stress the bearing systems and impact their operation.

N **13.2.6*** The energy storage management system (ESMS) of a FESS shall include bearing monitoring for magnetic bearings.

N **13.2.6.1** There shall be some means (e.g., alarm, hazard light, warning signal to control panel) to annunciate when bearing changes are due.

N **13.2.6.2*** The ESMS shall monitor and record temperature and vibration of the FESS.

N **13.2.7** FESS installed on elevated parking garages or roof tops, or in high-rise buildings shall meet the seismic requirements for that installation.

N **13.2.7.1** The seismic ratings of the FESS and suitability of mounting means shall be verified during installation.

N **13.2.7.2** The engineering analysis for a FESS installation in an elevated location shall address stresses on floor loading due to wind forces.

N **13.2.8*** An enclosure means to contain moving parts of the FESS shall be provided.

N **Table 13.2 FESS Technology-Specific Requirements**

Compliance Required	Applicable Chapter Reference	Chapter 13 Modifications
Construction documents	4.2	4.2.1.1 applies except as modified in 13.2.1 and 13.2.2 4.2.1.2—N/A 4.2.1.3—N/A 4.2.1.4—N/A
Emergency planning and training	4.3	4.3.2.1.4 applies except as noted in 13.2.2 4.3.2.1.5—N/A *(see 13.1.2)*
Hazard mitigation analysis (HMA)	4.4	4.4.1 applies except as noted in 13.2.3
Fire and explosion testing	9.1.5	N/A
Equipment	Section 4.6	See also 13.2.4 and 13.1.2
Retrofits	4.6.3	4.6.3.2—N/A 4.6.3.3—N/A *(see 13.1.2)*
Environment	4.6.7	See also 13.2.5
Charge controllers	4.6.8	N/A
Energy storage management systems	4.6.10	See also 13.2.6 and 13.2.6.1
Reused equipment	4.6.5	N/A
Seismic protection	4.7.2	See also 13.2.7 and 13.2.7.1
Fire barriers	9.6.4	N/A
Elevation	4.7.7	N/A *(see 13.2.7.2)*
Open rack installation	4.7.9	N/A
ESS dedicated-use buildings	9.3.1.1	N/A
Non-dedicated-use buildings	9.3.1.2	N/A
Outdoor installations	9.3.2	N/A
Enclosures	4.6.12	See also 13.2.8
Rooftop and open parking garage installations	9.5.3.1	N/A except as noted in 13.2.7, 13.2.7.1, and 13.2.7.2
Mobile ESS equipment and operations	9.5.3.2	9.5.3.2.1.2—N/A 9.5.3.2 applies *(see 13.2.9)* 9.5.3.2.2.2—N/A 9.5.3.2.5.3—N/A 9.5.3.2.6—N/A; requirements for deployed mobile FESS in accordance with Chapter 13
Size and separation	9.4.2	N/A
Maximum stored energy	9.4.1	N/A
Exhaust ventilation	9.6.5.1	N/A
Smoke and fire detection	Section 4.8	N/A *(see 13.2.10)*
Fire control and suppression	Section 4.9	N/A *(see 13.2.11)*
Explosion control	9.6.5.6	N/A *(see 13.2.8)*
Water supply	4.9.4	N/A
System interconnection	Chapter 5	Section 5.3—N/A
Commissioning	Chapter 6	See also Section 13.3
Operation and maintenance	Chapter 7	See also Section 13.4 7.1.3—N/A
Decommissioning	Chapter 8	See also Section 13.5

N/A: Not applicable.

N **13.2.9*** The rotor of mobile FESS shall be completely stopped (i.e., contain no energy) prior to transportation.

N **13.2.10** Smoke and fire detection for FESS installations shall be in accordance with the local building code.

N **13.2.11** Fire control and suppression for FESS installation shall be in accordance with the local building code.

N **13.2.12*** Separation or barriers shall be used to ensure that catastrophic failure of a flywheel does not propagate to other flywheels or energy storage systems in the area.

N **13.3* Commissioning.** Prior to commissioning, correct installation for mechanical securement and containment shall be confirmed.

N **13.4* Operation and Maintenance.** As part of routine maintenance there shall be procedures for monitoring/checking for bearing wear.

N **13.4.1** During installation, the AHJ shall confirm that the maintenance procedures have both a process for determining the bearing change interval and follow-up procedures.

N **13.4.2*** The AHJ shall confirm that the maintenance procedures include a check of the status of the vacuum on a periodic basis.

N **13.4.3 Spin Down.**

N **13.4.3.1** The maximum time to spin down shall be included in the maintenance documentation to ensure that the rotor has

coasted down to zero prior to maintenance or moving the FESS.

N 13.4.3.2 The technician shall make certain that they have confirmed the maximum spin down time for safety reasons.

N 13.5 **Decommissioning.**

N 13.5.1* For decommissioning, all the energy shall be completely dissipated from the FESS prior to FESS removal.

N 13.5.2 Rotor braking shall be required unless enough time is provided in the decommissioning procedures to allow it to spin down.

Δ Chapter 14 Storage of Lithium Metal or Lithium-ion Batteries

Δ 14.1 **Batteries.** Areas associated with the collection or storage of lithium metal or lithium-ion batteries shall comply with this chapter.

Δ 14.1.1 The following areas shall be exempt from the requirements of this chapter:

(1) Areas within a facility that are operated in accordance with procedures that provide for the state of charge of the lithium metal or lithium-ion batteries to be 30 percent or less
(2) Areas where fire and fault condition testing conducted or witnessed and reported by an approved testing laboratory is provided showing that a fire involving the batteries in storage will be limited to the design area of an automatic sprinkler system installed in accordance with NFPA 13 and will not adversely impact occupant egress from the building or adversely impact adjacent stored materials or the building structure
(3) Areas where new or refurbished batteries are installed for use in the devices, equipment, or vehicles they are designed to power
(4) Areas where new or refurbished batteries are packed for use with the devices, equipment, or vehicles they are designed to power
(5) Areas where new or refurbished batteries rated at no more than 300 Watt-hours (1.08 MJ) and lithium metal batteries containing no more than 25 g of lithium metal are in their original retail packaging
(6) Areas where batteries are staged in the manufacturing area or along assembly lines during the manufacturing process

14.1.2 The procedures and test report specified in 14.1.1 shall be provided to the AHJ for review and approval.

14.2 **Collection Locations.** All areas located indoors in any occupancy where used lithium metal or lithium-ion batteries are collected from employees or the public shall comply with 14.2.1 through 14.2.3.

14.2.1* Individual containers shall not exceed 7.5 ft^3 (0.21 m^3) in size each, with an aggregate limit of 15 ft^3 (0.42 m^3).

14.2.2 Containers shall comply with all of the following:

(1) Have a minimum of 3 ft (0.9 m) of open space from other battery collection containers and combustible materials
(2) Be located a minimum of 5 ft (1.5 m) from exits from the room, space, or building
(3) Be open-top and noncombustible or approved for battery collection use

14.2.3 Where combustible materials are located within the space between collection containers, the containers shall be spaced a minimum 10 ft (3 m) apart.

14.3 **Indoor Storage Locations.**

14.3.1 **General.**

Δ 14.3.1.1 Batteries stored indoors shall be stored in accordance with one or more of the methods provided for in 14.3.2.1 through 14.3.2.4.

14.3.1.2 Battery terminals shall be protected either through battery design methods or a protective packaging method to prevent short-circuit of the battery.

14.3.2 **Storage Methods.**

Δ 14.3.2.1 **Rooms or Spaces.** Batteries shall be permitted to be stored in rooms or spaces complying with 14.3.2.1.1 and 14.3.2.1.3.

14.3.2.1.1 The rooms or spaces shall be separated from the remainder of the building areas by fire barriers with a 2-hour fire resistance rating and with horizontal assemblies with a 2-hour fire resistance rating constructed in accordance with the local building code.

Δ 14.3.2.1.2 The rooms or spaces shall be provided with a fire alarm system activated by an air-aspirating smoke detector system or a radiant-energy detection system with occupant notification installed in accordance with *NFPA 72*.

N 14.3.2.1.3 The rooms or spaces shall be provided with an automatic sprinkler system designed and installed in accordance with NFPA 13.

Δ 14.3.2.2 **Prefabricated Portable Structure.** Batteries shall be permitted to be stored in prefabricated portable buildings or containers complying with 14.3.2.2.1 and 14.3.2.2.3.

N 14.3.2.2.1 The prefabricated portable buildings or containers shall be listed or approved with a 2-hour fire resistance rating.

N 14.3.2.2.2 The prefabricated portable buildings or containers shall be provided with a fire alarm system activated by an air-aspirating smoke detector system or a radiant-energy detection system with occupant notification installed in accordance with *NFPA 72*.

N 14.3.2.2.3 The prefabricated portable buildings or containers shall be provided with an approved automatic fire sprinkler system installed in accordance with NFPA 13.

14.3.2.3 **Metal Drums.** Batteries shall be permitted to be stored in metal drums with batteries separated from each other by vermiculite or other approved material or in containers approved for battery collection and storage activities complying with 14.3.2.3.1 and 14.3.2.3.3.

Δ 14.3.2.3.1 Each area containing such metal drums or approved containers shall be both of the following:

(1) Not exceeding 900 ft^2 (61 m^2) in area
(2) Separated from other battery storage areas by a minimum of 10 ft (3 m)

14.3.2.3.2 Each area containing metal drums or approved containers with batteries shall be provided with a fire alarm

system activated by an air-aspirating smoke detector system or a radiant-energy detection system with occupant notification installed in accordance with *NFPA 72*.

N **14.3.2.3.3** Each area containing metal drums or approved containers with batteries shall be provided with an approved automatic fire sprinkler system installed in accordance with NFPA 13.

14.3.2.4 Containers Approved for Transportation. Batteries shall be permitted to be stored in containers approved for use in transportation that will prevent an event from propagating beyond the container complying with 14.3.2.4.1 and 14.3.2.4.3.

Δ **14.3.2.4.1** Each area containing the approved transportation containers shall be both of the following:

(1) Not exceeding 900 ft^2 (61 m^2) in area
(2) Separated from other battery storage areas by a minimum of 10 ft (3 m)

14.3.2.4.2 Each area containing the approved transportation containers shall be provided with a fire alarm system activated by an air-aspirating smoke detector system or a radiant-energy detection system with occupant notification installed in accordance with *NFPA 72*.

N **14.3.2.4.3** Each area containing the approved transportation containers shall be provided with an approved automatic fire sprinkler system installed in accordance with NFPA 13.

14.4 Prevention and Mitigation. A plan that provides for the prevention of fire incidents and includes early detection mitigation measures shall be provided to the AHJ for review and approval.

N **14.5 Explosion Protection.**

N **14.5.1 Deflagration Potential.**

N **14.5.1.1** The potential for a deflagration involving the off-gassing of flammable gases during a thermal runaway shall be analyzed.

N **14.5.1.2** Explosion protection shall be installed if the potential for a deflagration involving the off-gassing of flammable gases during a thermal runaway exists.

N **14.5.2** A written hazard analysis prepared by a registered design professional with expertise in fire protection engineering shall be submitted to the AHJ for review and approval.

14.6 Outdoor Storage Location.

14.6.1 Outdoor storage locations for lithium metal or lithium-ion batteries shall comply with the following:

(1) Individual pile sizes shall be limited to 900 ft^2 (83.6 m^2) in area separated from other piles by 10 ft (3 m).
(2) Piles located outdoors shall be separated by a minimum 20 ft (6.1 m) from the following exposures:
    (a) Lot lines
    (b) Public ways
    (c) Buildings
    (d) Other storage
    (e) Hazardous materials
    (f) Other exposure hazards

14.6.2 Clearances shall be permitted to be reduced to 3 ft (0.9 m) where a 3-hour freestanding fire barrier, suitable for exterior use, and extending 5 ft (1.5 m) above and extending 5 ft (1.5 m) beyond the physical boundary of the pile is provided to protect the exposure.

N **14.6.3 Weather Protection.** Where weather protection is provided for sheltering outdoor battery storage areas, such areas shall be considered outdoor storage areas if all of the following conditions are met:

(1) Supports and walls shall not obstruct more than one side or more than 25 percent of the perimeter of the storage area.
(2) The distance from the structure and the structural supports to buildings, lot lines, public ways, or means of egress to a public way shall be not less than the distance required by 14.6.1 for outdoor storage of batteries without weather protection.
(3) The structure shall be of approved noncombustible construction and not exceed 3,600 ft^2 (334.5 m^2) in area.

N **14.6.4** Outdoor storage areas with an aggregate area greater than 400 ft^2 (37.1 m^2) shall be provided with a fire alarm system activated by a radiant-energy detection system with occupant notification installed in accordance with *NFPA 72*.

Chapter 15 One- and Two-Family Dwellings and Townhouse Units

15.1* General. ESS installations with a rating of 1 kWh (3.6 MJ) or greater and associated with one- or two-family dwellings or townhouse units shall comply with the requirements of this chapter.

15.2 Equipment Listings.

Δ **15.2.1** ESS shall be listed and labeled in accordance with UL 9540.

15.3 Installation. ESS shall be installed in accordance with the manufacturer's instructions and their listing.

15.3.1 ESS Spacing. Individual ESS units shall be separated from each other by a minimum of 3 ft (914 mm) unless smaller separation distances are documented to be adequate based on fire and explosion testing complying with 15.13.

N **15.3.2 Labeling.** A label containing emergency contact information for the qualified service and maintenance providers shall be provided on the exterior of the installed ESS.

15.4 Locations.

15.4.1 ESS shall only be installed in the following locations:

(1) In attached garages separated from the dwelling unit living area and sleeping units in accordance with the local building code
(2) In detached garages and detached accessory structures
(3) Outdoors on exterior walls or on the ground located a minimum of 3 ft (914 mm) from doors and windows directly entering the dwelling unit
(4) In enclosed utility closets and storage or utility spaces where approved by the AHJ

15.4.2 If the room or space where the ESS is to be installed is not finished or noncombustible, the walls and ceilings of the room or space shall be protected with not less than 5/8 in. Type X gypsum board.

15.4.3 ESS shall not be installed in sleeping rooms, or in closets or spaces opening directly into sleeping rooms.

Δ **15.5 Energy Ratings.**

N **15.5.1** Individual ESS units shall have a maximum stored energy of 20 kWh.

15.5.2 The aggregate rating of the ESS shall not exceed the following for each location listed:

(1) 40 kWh within utility closets, basements, and storage or utility spaces
(2) 80 kWh in attached or detached garages and detached accessory structures
(3) 80 kWh where outdoor wall mounted
(4) 80 kWh where outdoor ground mounted

15.5.3 ESS installations exceeding the individual or aggregate ratings allowed by 15.5.1 or 15.5.2 shall comply with Chapters 4 through 9.

15.5.4* The use of an electric-powered vehicle to power the dwelling while parked shall comply with Section 15.11.

15.6 Electrical Installation. ESS shall be installed in accordance with *NFPA 70*.

15.6.1 Inverters shall be listed and labeled in accordance with UL 1741 or provided as part of the UL 9540 listing.

15.6.2* Systems connected to the utility grid shall use inverters listed for utility interaction.

15.7 Fire Detection.

15.7.1 Rooms and areas within dwelling units, basements, and attached garages in which ESS are installed shall be protected by interconnected smoke alarms in accordance with the local building code.

15.7.2 A heat detector or alarm, listed and interconnected to the smoke alarms, shall be installed in locations within dwelling units and attached garages where smoke alarms cannot be installed in accordance with their listing.

15.8 Protection from Impact. ESS installed in a location subject to vehicle damage shall be protected by approved barriers.

Δ **15.9 Exhaust Ventilation.** Indoor installations of ESS that include batteries that produce hydrogen or other flammable gases during charging shall meet the exhaust ventilation requirements in accordance with 9.6.5.1.

15.10 ESS Toxic and Highly Toxic Gas Release During Normal Use. ESS that have the potential to release toxic or highly toxic gas during charging, discharging, and normal use conditions shall be installed outdoors.

15.11 Electric Vehicle Use.

15.11.1 The temporary use of the dwelling unit owner's or occupant's electric-powered vehicle to power the dwelling while parked in an attached or detached garage or outside shall comply with the vehicle manufacturer's instructions and *NFPA 70*.

15.11.2 Temporary emergency use of the dwelling unit owner's or occupant's electric-powered vehicle to power the dwelling while parked in an attached or detached garage or outside shall be permitted.

N **15.12* Test Reports.** ESS installed in accordance with Chapter 15 shall be provided with a product-level evaluation by an approved qualified person with expertise in energy storage as a supplemental safety document to be used by the AHJ and the installing contractors.

N **15.13 Fire and Explosion Testing.**

N **15.13.1*** Where required by 15.3.1, fire and explosion testing shall be conducted on a representative ESS in accordance with UL 9540A or equivalent test standards.

N **15.13.1.1** The complete UL 9540A or equivalent test report shall be provided to the authority having jurisdiction, including the cell, module, and unit level.

N **15.13.1.2** Lead-acid and nickel-cadmium batteries used in standby power systems and listed to UL 1973 shall not require UL 9540A testing when installed with a charging system listed to UL 1012, UL 60950-1, or UL 62368-1, or a UPS listed to UL 1778.

N **15.13.1.3** The testing shall be conducted, witnessed, and reported by an approved testing laboratory to characterize the composition of the gases generated and show that a fire involving one ESS unit will not propagate to an adjacent unit.

N **15.13.1.4*** The representative cell, modules, and units tested, including any optional integral fire suppression system, shall match the intended installation configuration other than the addition of the cell failure mechanism utilized for cell thermal runaway initiation.

N **15.13.1.5** The testing shall include evaluating deflagration mitigation measures when designed into ESS cabinets.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

N **A.1.1** Energy generation equipment—even if it is tied to the ESS—is not covered under the scope. An example of this is a solar energy farm that feeds ESS on the same property. The solar generation and collection equipment are not governed by this standard. NFPA 850 or other relevant standard should be applied for the design, construction, installation, commissioning, operation, and maintenance of generation facilities.

A.1.3 It is not the intent of NFPA 855 to regulate equipment with integral standby power systems below the amounts in Table 1.3, such as emergency lighting units, fire alarm control units, computers, tablets, and other appliances and equipment.

Flywheel ESS have a lower energy threshold quantity because the stored energy can be released much more quickly in the case of a catastrophic failure. They are normally utilized for short-term and high-power applications. Although flywheel ESS do not represent the potential for fire hazards in the same manner as electrochemical systems, their total energy and size should be limited because of concerns with hazardous moving parts and structural concerns associated with containing those parts.

N **A.1.3.1** Where approved by the AHJ, alternate safety requirements can be applied for purpose of research, development, or testing.

A.1.4.2 In order to help determine if an existing ESS installation presents an unacceptable risk and that retroactivity should apply, the AHJ can request a hazard mitigation analysis be submitted by the owner in accordance with Section 4.4.

Based on the hazardous mitigation analysis, the AHJ can apply retroactively any portions of this standard deemed appropriate to mitigate any hazards that could be identified in the risk assessment as unacceptable.

A.1.5 Data and analysis that documents equivalency with the intent of this standard should be prepared and submitted to the AHJ.

Δ **A.3.2.1 Approved.** The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment, or materials, the "authority having jurisdiction" may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The "authority having jurisdiction" may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA standards in a broad manner because jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.1 Apartment Building. NFPA *101* specifies that, wherever there are three or more living units in a building, the building is considered an apartment building and is required to comply with either the provision of Chapter 30 or Chapter 31 of NFPA *101*, as appropriate. Townhouse units are considered to be apartment buildings if there are three or more units in the building. The type of wall required between units in order to consider them to be separate buildings is normally established by the authority having jurisdiction. If the units are separated by a wall of sufficient fire resistance and structural integrity to be considered as separate buildings, then the provisions of Chapter 24 of NFPA *101* apply to each townhouse. Condominium status is a form of ownership, not occupancy; for example, there are condominium warehouses, condominium apartments, and condominium offices. [*101*, 2021]

A.3.3.2.1 Flow Battery. Typically, a flow battery includes storage tanks and pumps.

N **A.3.3.3 Battery Management System (BMS).** The BMS can include functions necessary to control charging, discharging, thermal management, shutdown, and mitigation in both normal and abnormal conditions. The BMS can be completely independent of the ESMS.

A.3.3.5.1 One- and Two-Family Dwelling Unit. The application statement of 24.1.1.1 of NFPA *101* limits each dwelling unit to being "occupied by members of a single family with not more than three outsiders." NFPA *101* does not define the term *family*. The definition of family is subject to federal, state, and local regulations and might not be restricted to a person or a couple (two people) and their children. The following examples aid in differentiating between a single-family dwelling and a lodging or rooming house:

(1) An individual or a couple (two people) who rent a house from a landlord and then sublease space for up to three individuals should be considered a family renting to a maximum of three outsiders, and the house should be regulated as a single-family dwelling in accordance with Chapter 24 of NFPA *101*.
(2) A house rented from a landlord by an individual or a couple (two people) in which space is subleased to 4 or more individuals, but not more than 16, should be considered and regulated as a lodging or rooming house in accordance with Chapter 26 of NFPA *101*.
(3) A residential building that is occupied by 4 or more individuals, but not more than 16, each renting from a landlord, without separate cooking facilities, should be considered and regulated as a lodging or rooming house in accordance with Chapter 26 of NFPA *101*.

[*101*, 2021]

A.3.3.7 Electrochemical Double Layer Capacitor (EDLC). These capacitors can also be referred to as ultra-capacitors, super capacitors, double layer capacitors, electrochemical capacitors, and so forth.

A.3.3.8 Energy Storage Management System (ESMS). Some standards refer to this as an energy management system (EMS). This system can control one or more individual management systems, such as battery management systems (BMS).

A.3.3.9 Energy Storage Systems (ESS). ESS include but are not limited to the following categories:

(1) Chemical: hydrogen storage
(2) Thermal: thermal energy storage
(3) Electrochemical:
    (a) Batteries
    (b) Flow batteries
(4) Mechanical:
    (a) Flywheel
    (b) Pumped hydro
    (c) Compressed air energy storage (CAES)
(5) Electrical:
    (a) Capacitors
    (b) Superconducting magnetic energy storage (SMES)

These systems can have ac or dc output for utilization and can include inverters and converters to change stored energy into electrical energy. It is not the intention for ESS to include energy generation systems.

Energy storage systems can include, but are not limited to, batteries, capacitors, and kinetic energy devices (e.g., flywheels). Energy storage systems can include inverters or converters to change voltage levels or to make a change between an ac or a dc system. These systems differ from other storage systems such as a UPS system, which is a power supply used to provide alternating current power to a load for some period of time in the event of a power failure.

A.3.3.9.1.1 Electrochemical Energy Storage System. The electrochemical energy is related to fuel cells, photoelectrochemical cells, and systems such as batteries.

A.3.3.9.1.2 Mechanical Energy Storage System. The mechanical energy is related to fly wheels, pump storage, compressed air systems, and systems such as reservoirs, pressure vessels, or magnets.

N **A.3.3.13 Flywheel Energy Storage System (FESS).** There are primarily two types of rotor constructions—solid-metal-mass design and composite fiber design.

N **A.3.3.13.1 Braking.** Power generated from the rotor is consumed by the internal losses of the FESS. Braking can be done in a manner to create significant rotor losses to reduce braking time.

N **A.3.3.13.2 Spin Down.** A complete stop of the flywheel rotor cannot occur instantaneously because of the high kinetic energy of the rotor, but rather occurs over time due to a gradual slowdown to a stop as a result friction forces acting on the rotor. During spin down, active unloading, such as magnetic bearings might or might not be present.

N **A.3.3.22 Repurposed Battery.** An example of a repurposed battery is a stationary energy storage battery that has been built using used electric vehicle batteries, modules, or cells. Another term for a repurposed battery is *second-life battery.*

N **A.3.3.26 Thermal Runaway.** Thermal runaway progresses when the cell's generation of heat is at a higher rate than the heat it can dissipate.

A.4.1 Chapter 4 requirements are intended to be applicable to all ESS technologies. However, it is recognized that hazards and mitigation requirements differ among the various ESS technologies covered by Chapters 9 through 15. This section allows requirements in those chapters to supplement or supersede the general requirements of Chapter 4.

ESS should comply with NFPA 111 where adopted and where intended for use as a stored-energy emergency power supply system (SEPSS).

A.4.2.3(3) The term personnel can refer to a call center, an individual, or department that has responsibility for the operation and maintenance of the ESS.

A.4.3.1 NFPA 1620 provides criteria for developing pre-incident plans for use by personnel responding to emergencies. It can be a useful resource to help in the development of pre-incident plans to assist personnel in effectively managing incidents and events for the protection of occupants, responding personnel, property, and the environment.

A.4.3.2.1.4(3) The energy storage management system (ESMS) monitors and responds to a variety of normal out-of-range conditions from the BMS or other monitoring devices in the system or installation. Many of these conditions are associated with routine operating conditions, such as battery or module temperatures, state of charge, voltages, and currents. Decisions about when and how much to charge/discharge the batteries are typically delegated to the ESMS or charger, while the BMS is responsible for enforcing a safe operating window for the batteries. Often, the BMS has direct control of an interrupt device that isolates the battery from potential or hazardous operation. Additionally, the BMS can elevate warnings or alarms to the ESMS, which is then responsible for appropriately restricting operation. Other important functions of an ESMS are the recording of data, alarms, and condition/events into a history log and managing or monitoring communications between all subsystems. Notification of elevated conditions can go to a control/monitoring center for evaluation, with some resulting in the control/monitoring center notifying the fire department or other responding organization. All conditions that necessitate such a notification along with their recommended responses should be included in the facility emergency operations plan.

A.4.3.2.1.4(4) Procedures can include sounding the alarm, notifying the fire department, evacuating personnel, de-energizing equipment, and controlling and extinguishing the fire.

Δ **A.4.4.1** One form of hazard mitigation analysis (HMA) is a failure mode and effects analysis (FMEA), which is a systematic technique for failure analysis. An FMEA is often the first step of a system reliability study and involves reviewing as many components, assemblies, and subsystems as possible to identify failure modes and their causes and effects. For each component, the failure modes and their resulting effects on the rest of the system are recorded. Other formal methodologies for conducting the analysis can also be used depending on the complexity and type of the system being assessed. Guidance for analysis can be found in the following standards:

(1) IEC 60812
(2) IEC 61025
(3) MIL-STD-1629A

The mixing of lead-acid batteries with nickel-cadmium batteries should not present a risk of adverse interaction. An HMA might not be necessary for these installations.

Many ESS will be provided with safety equipment to meet the requirements of UL 9540, but in some circumstances additional safety equipment might need to be provided over and above what is included with the ESS. For example, an ESS installed indoors might depend upon exhaust ventilation provided with the installation in accordance with 9.6.5.1 to remove gases from the building. In this case, the HMA would need to address possible failures of such a system. It is not the intent of the HMA to evaluate the safety equipment provided as part of a listed ESS unless that equipment is installation dependent as determined by the testing to UL 9540 and UL 9540A.

N **A.4.4.2.1** Failures modes covered by 4.4.2 can include mechanical failure modes and are applicable to flywheel, stored pressure, and other types of ESS other than electrochemical ESS.

A.4.4.5 In order for the ESS to comply with the hazard mitigation analysis acceptance criteria, the building owner could be

requested to provide construction, equipment, and protection systems in addition to those identified in this standard. This section clarifies that these protection measures must be installed, tested, and maintained in accordance with nationally recognized standards.

A.4.6.1 It is envisioned that equipment provided will be listed in accordance with UL 9540. ESS that are not listed in accordance with UL 9540 should be documented and verified as meeting the provisions of this standard using the equivalency requirements in Section 1.5, where technical documentation provided shows the ESS that is proposed results in a system that is no less safe than a system meeting the construction and performance requirements of UL 9540. If nonlisted equipment is to be evaluated for compliance with UL 9540, the evaluation and documentation should be provided as part of a field evaluation conducted by an approved third-party certification organization.

In specific instances, this standard will not require equipment such as lead-acid batteries to be listed or they can be listed to UL 1973 instead of UL 9540.

N **A.4.6.3.2** Paragraph 4.6.3.2 aligns with 90.2(B)(4) of *NFPA 70*.

N **A.4.6.9.1** UL 9540 requires inverters, chargers, and charge control equipment that are part of an ESS to be designed and rated for use with the battery system employed in the ESS and evaluated to UL 1741, UL 62109-1, CAN/CSA C22.2 No. 62109-1, UL 1012, UL 1778, or CAN/CSA C22.2 No. 107.1 as applicable to the power conversion equipment and its application in the system. UL 9540 also requires power conditioning systems for standalone and multi-mode applications to comply with UL 1741, UL 62109-1, CAN/CSA C22.2 No. 62109-1, or CSA C22.2 No. 107.1.

A.4.6.9.2 A utility-interactive inverter forms a protective barrier between the dc power source side of the inverter and the ac utility interface. In the event of an out-of-tolerance utility connection, the inverter shuts down the ac output to the utility grid. Inverters and converters might have to meet the requirements of IEEE 1547 if required by the utility interconnection requirements for ESS paralleled with the utility system.

A.4.6.10 The most common form of energy storage management system is a battery management system that plays a critical role in verifying that the system parameters identified are maintained within safe values for the ESS technology involved. In addition to shutting down the system, the ESMS can also transmit system status conditions to on-site and off-site personnel to notify them of the off-normal condition.

Δ **A.4.6.11** It is not the intent of 4.6.11 to address the presence of toxic and highly toxic gases that are produced during abnormal conditions, such as a fire in the building.

N **A.4.7.1** Installations of communications equipment, including batteries, under the exclusive control of communications utilities located outdoors or in building spaces used exclusively for such installations are not covered by *NFPA 70* and need not comply with the requirements of *NFPA 70*.

Adequate working space is vital for electrical safety-related work practices. Articles 110 and 706 of *NFPA 70* provide working space requirements for electrical equipment. NECA 416 is another installation standard that provides guidelines for working space requirements.

A.4.7.4 Signage provides important information for firefighters and emergency responders who respond to a fire or other incident in a building or facility in which ESS is contained. Being able to quickly understand the following is critical to maintain their safety:

(1) The presence and location of multiple disconnects that can be used to de-energize and isolate portions of the electrical system
(2) The location of ESS rooms and areas and the types of ESS within the room or area
(3) Significant hazards associated with the ESS technology present

The intent of this standard is to allow flexibility in the exact wording used on required signage so conflicts are not created with other codes and standards.

Some jurisdictions can choose to supplement these required markings with NFPA 704 hazard identification system markings or the firefighter safety building marking system described in Annex E of NFPA 1. However, some ESS technologies have hazards not clearly categorized in the hazard ranking system or present no hazards.

A.4.7.4.2 This sign can be broken into multiple segments. An example of this would be if the manufacturer provides their own separate signage about the fire suppression system.

A.4.7.5.3 Guard post spacing can be required with greater spacing requirements based on location.

A.4.7.5.4 ESS installed in residential garages should not be installed in a location where a motor vehicle being parked in the garage could come in contact with the ESS. Protection can be provided by approved barriers, by locating the ESS upon a 6 in. (152.4 mm) high platform located to the side of the garage, by locating the ESS components at a level above the potential impact height, or by recessing the ESS to one side of the space where the garage door is not the full width of the garage.

N **A.4.7.7.3(1)** Paragraph 4.7.7.3(1) aligns with 90.2(D)(4) of *NFPA 70*.

A.4.7.7.3(2) This is in line with the scope of 90.2(D)(5) of *NFPA 70* and applies to lead-acid or nickel-cadmium batteries.

A.4.7.12 Classified areas might contain hazardous and flammable atmospheres that could damage an ESS installation. ESS installations might also provide an ignition source for these atmospheres unless properly listed. See *NFPA 70*, IEEE C2, NFPA 497, or NFPA 499 for more information.

N **A.4.8.1** Very early warning smoke detection systems can provide an earlier indication of a potential fire with an ESS.

For lithium-ion ESS, a smoke detection system can be supplemented by a listed or approved off-gas detection system. Off-gas detection can increase the effectiveness of the smoke detection system for providing early response of an off-normal condition.

Gas detection technology can also provide additional information on conditions inside the ESS enclosure.

Δ **A.4.8.1.1** Paragraph 4.8.1.1 aligns with 90.2(B)(4) of *NFPA 70*.

This requirement is intended to address small, normally unoccupied structures in remote locations, such as repeater

stations, which are not adjacent to other important buildings or structures. It is not intended to apply to structures in an urban or suburban setting. The AHJ determines which structures are considered remote. The hardship of installing and maintaining smoke detection in these small, remote structures, along with heating and cooling to maintain the smoke detectors within listing specifications, is a reason for this exclusion.

See NFPA 76 for more information on fire detection for telecommunications structures.

Δ **A.4.8.1.2** Paragraph 4.8.1.2 aligns with the scope of 90.2(D)(5) of *NFPA 70*.

N **A.4.8.2.2** As part of the smoke detection system's local annunciation, providing a fire alarm annunciation panel for emergency responders in an approved location where it can annunciate the ESS(s) being monitored should be considered. The location and information provided should be covered by the emergency operations plan required by 4.3.2.1 and evaluated as part of the HMA.

N **A.4.8.3** The HMA or deflagration evaluation study in conjunction with UL 9540A or fire and explosion test data will be used to support the requirement for additional power supply backup above and beyond *NFPA 72* requirements. This requirement applies to lithium-ion technologies because testing and actual events have shown that events can be several hours in duration. The additional backup will allow first responders to monitor situational conditions for longer periods of time.

Δ **A.4.9.1** Fire control and suppression is only required to protect ESS when so specified elsewhere in the standard, such as Table 9.5.1, Table 9.5.2, and Table 9.5.3.1.

The fire control and suppression systems requirements in this section are intended to provide protection in ESS rooms and outdoor walk-in units containing ESS. The protection serves the following two purposes:

(1) Protect the building and nearby exposures from a fire initiating in the ESS
(2) Provide protection for ESS from an external exposure fire that impinges on the ESS

A phased approach to suppression can mitigate failure points and limit fire impacts that can potentially lead to thermal runaway or other more severe fire conditions.

N **A.4.9.1.1** Paragraph 4.9.1.1 aligns with 90.2(B)(4) of *NFPA 70*.

A.4.9.1.3 This is in line with the scope of 90.2(D)(5) of *NFPA 70* and applies to lead-acid or nickel-cadmium batteries.

A.4.9.2.2 UL 9540A Installation Level Test, Method 1, provides the data needed to determine if automatic sprinkler design densities can be changed. A sprinkler density in excess of 0.3 gpm/ft^2 (12.2 mm/min) can be necessary to provide an adequate level of protection, especially for some lithium-ion battery ESS designs. However, test results for some ESS designs and technologies indicate sprinkler densities less than 0.3 gpm/ft^2 (12.2 mm/min) could be acceptable. Equivalent test standards, as permitted in 9.1.5, might provide comparable data.

A.4.9.3.1 UL 9540A Installation Level Test, Method 2, provides the data needed to determine if other fixed fire control and suppression systems are suitable for the application. Equivalent test standards, as permitted in 9.1.5, can provide comparable data.

Δ **A.4.9.3.2** *Gaseous Agents.* Gaseous agent fire suppression systems can be used to protect ESS fires in either of the following two ways:

(1) Total flooding systems are used where there is a permanent enclosure around the fire hazard that is adequate to enable the design concentration to be built up and maintained for the time required to ensure the complete and permanent extinguishment of a fire for the specific combustible materials involved. For total flooding systems, potential leakage sources should be included in the gaseous agent design quantities, which should include leakage through ventilation dampers. Usually, ventilation dampers are either gravity actuated (i.e., close when the ventilation fans automatically shut down upon gaseous agent discharge) or pressure actuated (i.e., close by means of counterweight and a pressure-operated latch that is activated by the gaseous agent). Leakage from the interface between the enclosure walls and the foundation should also be taken into consideration. For ESS enclosures where the normal temperature of the enclosure exceeds 200°F (93°C) or is below 0°F (−18°C), gaseous agent levels should be adjusted as required by the appropriate NFPA standard or the manufacturer's instruction manual.
(2) Local application systems are used for the extinguishment of surface fires of combustible gases, liquids, or solids where the fire hazard is not enclosed or where the enclosure does not conform to the requirements for a total flooding system. For local application systems, it is imperative that the entire fire hazard be protected. The hazard area should include all areas that are subject to spillage, leakage, splashing, condensation, and so forth and are of combustible materials that might extend a fire outside the protected area or lead a fire into the protected area. This type of hazard could necessitate dikes, drains, or trenches to contain any combustible material leakage. When multiple ESS equipment fire hazards are in an area such that they are interposing, provisions should be made to ensure that the hazards can be protected simultaneously, which could involve subdividing the hazards into sections and providing independent protection to each section.

See G.6.1.4 for more information on the use of gaseous/clean agent fire suppression with LIB-based ESS.

Water Mist. Water mist fire suppression systems need to be designed specifically for use with the size and configuration of the specific ESS installation or enclosure being protected. Currently there is no generic design method recognized for water mist systems. System features such as nozzle spacing, flow rate, drop size distribution, cone angle, and other characteristics need to be determined for each manufacturer's system through fire and explosion testing in accordance with 9.1.5 to obtain a listing for each specific application and must be designed, installed, and tested in accordance with NFPA 750.

See G.6.1.3 for more information on the use of water mist systems with LIB-based ESS.

A.4.9.4.1 Water supplies could be one or any combination of the following:

(1) A connection to an approved public or private waterworks system
(2) A connection including a fire pump
(3) A connection to a water storage tank at grade or below grade installed in accordance with NFPA 22 and filled from an approved source
(4) A connection to a pressure tank and filled from an approved source
(5) A connection to a gravity tank and filled from an approved source
(6) A penstock, flume, river, lake, pond, or reservoir
(7) A cistern
(8) A source of recycled or reclaimed water where the building owner (or their agent) has analyzed the water source and the treatment process (if any) that the water undergoes before being made available and determined that any materials, chemicals, or contaminants in the water will not be detrimental to the components with which it is in contact

N **A.5.4** There are a number of requirements for protective features to be built into the ESS or buildings that house ESS. Consideration should be given to provide for the grouping of systems, controls, and monitoring for safe access for those who respond to these incidents as approved by the AHJ. The location can include FACP annunciation to include, fire, trouble, supervisory, dry standpipe hose connection, e-stop, remote ventilation control, and high-gas notification.

A.6.1.1.2 The North American Electric Reliability Corporation (NERC) and Federal Energy Regulatory Commission (FERC) are two examples of entities that have, or are developing, commissioning requirements for electric utilities ESS installations that form the basis for governmental laws and regulations.

A.6.4 After an ESS is commissioned and put into operation, it becomes an existing system. There could come a time when that existing system or impacted portion of a system is altered, repositioned, added to, renovated, or in some way modified beyond simple service or replacement of in-kind parts and components. When any of those activities are conducted on the system, there is no documentation or verification that the system will properly operate (e.g., the original commissioning plan and commissioning report would not necessarily support the system since it was modified in some way by one or more of these activities). That necessitates the resultant system be commissioned again. While the term recommissioning might be used in this case, that term can also be used to describe the conduct (again) of an initial commissioning activity on a new system where that initial commissioning process failed and was redone. With respect to an existing system or impacted portion of a system that has been modified in some way, the intent of the standard is simply to recommission the system in accordance with the recommissioning requirements in Section 6.4.

A.6.4.2 Listed software changes should be considered system renewals because it is a listed change.

A.6.4.4 When listed ESS is modified in the field, it can change its ability to comply with the requirements in the standard used to list the product. It is difficult or impossible for AHJs and service personnel to verify that the modified product complies with those requirements. Certification organizations have the expertise to evaluate modifications and have field evaluation programs to investigate the modified product and provide a field evaluation label on the product. It is not anticipated that a field evaluation is needed to evaluate modifications that are identified in the instruction manual provided with the listed equipment, such as swapping out or adding listed modules. It is also not anticipated that a field evaluation is needed for like-for-like repairs that do not impair the overall safety of the product.

A.7.1.2(5) Examples of engineering documentation include one-line diagrams, lock-out/tag-out procedures, and shock and arc flash labeling.

N **A.7.2** IEEE 3007.1 provides guidance on ESS maintenance.

A.8.1.2 The North American Electric Reliability Corporation (NERC) and Federal Energy Regulatory Commission (FERC) are two examples of entities that have, or might be developing, decommissioning requirements of ESS installations for electric utilities that form the basis for governmental laws and regulations.

A.8.1.3 Considerations that should be included in the decommissioning plan would include but not be limited to the following:

(1) An identification of all energy sources (batteries, connected batteries in other enclosures or structures), inverters [also known as *power conversion systems* (PCS)], dc bus precharge power supplies, UPS, support equipment with batteries, and ac or dc auxiliary power equipment and distribution systems
(2) Information about PPE and requirements for use as needed (site dependent), noting that each electrical equipment cabinet should already have shock and arc flash warning labels applied as per *NFPA 70E*
(3) A notification that the ESS should be discharged to its safe state of charge (SOC) for transport
(4) Assurance that during the decommissioning process, critical support equipment such as, but not limited to, fire detection and suppression equipment, emergency lighting, electrical circuits to facilitate decommissioning, and so forth, remain operational to the extent possible
(5) A warning not to disconnect any ESS grounding until all energy sources are isolated and locked out
(6) A notification to disconnect and shut down all batteries and support or auxiliary equipment associated with the system or its component parts
(7) Isolation of all energy sources, starting with those with highest fault energy, by isolating the ac point of interconnection, then isolating strings, then isolating the individual battery modules
(8) The need to mechanically uninstall battery trays and place them into original or equivalent packing materials or protect terminals
(9) Assurance that the materials are properly classified and packaged based on regulations governing the classification before removing material from the site (e.g., requirement that shipments on public roads comply with DOT regulations, including UN/DOT 38.3-tested packing for Li-ion batteries and UN 2800 for VRLA nonspillable batteries)
(10) The need to remove batteries from other equipment associated with the system as part of decommissioning and prior to removal

A.9.1.1 Annex B includes information on general hazards associated with ESS. Section B.5 provides a description of commercially available battery technologies and the hazards associated with them.

N **A.9.1.3** Capacitors used for utility applications that are not included in this chapter for capacitor ESS are typically technologies that have metallized film electrodes with a polymer film (polypropylene) and aromatic hydrocarbon fluid dielectric and are referred to as metallized film capacitors or all film capacitors.

Δ **A.9.1.5.1** A UL 9540A test or equivalent test should evaluate the fire characteristics of the composition of gases generated at cell level, module level, and unit and installation levels for an indoor installation of an ESS that undergoes thermal runaway, such as what might occur due to a fault, physical damage, or exposure hazard. The evaluation of the fire characteristics during fire vent testing at the unit level and indoor installation level testing should document whether the fire event propagates to the neighboring ESS units and include radiant heat flux measurements at enclosing wall surfaces and at various distances from the ESS being tested at the unit level. The data generated by the fire and explosion testing is intended to be used by manufacturers, system designers, and AHJs to determine the need for fire and explosion protection required for an ESS installation.

N **A.9.1.5.1.3** Changes in an installation configuration, including the internal architecture of modules and units, that don't match the parameters tested, such as size and separation, cell type, or energy density, should not be accepted unless it can be shown that the configuration provides equivalent results. For example, scaling such as height, depth, and spacing need to conform to the configuration of the test. Changes also might include multiple levels of units on top of each other, located on a mezzanine floor above, or back-to-back units. These configurations might not have been evaluated in the test.

A.9.1.5.2 The test report will provide nonproprietary information that, among other things, describes the size and energy capacity rating of the unit being tested, model numbers of the modules and ESS units, orientation of ESS in the test facility, and proximity of the ESS unit under test to adjacent ESS, walls, and monitoring sensors. The test report also includes a complete set of test results and measurements. For example, a complete UL 9540A test report that includes a unit level test should also include the UL 9540A cell and module level test.

N **A.9.2.1.2.1** Lead-acid and nickel-cadmium batteries listed to UL 1973 are often assembled with listed chargers and other listed components for use in stationary standby applications. In these instances, listing at the system level to UL 9540 might not be necessary for installations less than 600 V dc.

N **A.9.2.1.2.2** Paragraph 9.2.1.2.2 aligns with 90.2(D)(4) of *NFPA 70*.

A.9.2.1.2.3 This subsection is in line with the scope of 90.2(D)(5) of *NFPA 70* and applies to lead-acid or nickel-cadmium batteries.

N **A.9.2.3.1** Where the ESS operates in parallel to the electric utility grid, the ESMS or BMS should meet the operating requirements of the utility interconnection and any minimum legal requirements.

Lead-acid and nickel cadmium battery systems typically do not require or include an ESMS or BMS.

N **A.9.2.3.2** Annex B provides a partial list of potential hazard conditions, which can vary for each ESS type.

A.9.2.3.3 Local visible annunciation, when required by the AHJ, is intended to provide on-scene emergency responders with information about potentially hazardous conditions with the ESS so appropriate deployment tactics can be taken. It is not the intent of this section to require the ESMS to transmit alarm signals to an off-site locale. The ESS manufacturer is most qualified to identify conditions with its equipment that constitutes a hazardous, not just abnormal, condition. These conditions typically include high temperature but might also include other conditions such as overcharge, short circuit, etc. The AHJ should consult with individuals responsible for the system to verify that the conditions used to identify a hazardous condition are understood and acceptable, and the location of the unit in trouble is adequately identified.

Visible annunciation can consist of a colored light on an ESS unit, an annunciation panel, or other approved means.

N **A.9.2.3.4.1** Paragraph 9.2.3.4.1 aligns with 90.2(B)(4) of *NFPA 70*.

A.9.2.3.4.2 This is in line with the scope of 90.2(D)(5) of *NFPA 70* and applies to lead-acid or nickel-cadmium batteries.

N **A.9.2.4.2** UL 1974 is a factory process standard that covers the sorting and grading process of battery packs, modules and cells, and electrochemical capacitors that were originally configured and used for other purposes, such as electric vehicle propulsion, and that are intended for a repurposed-use application, such as for use in energy storage systems. It includes requirements for quality control for factory facilities and processes such as sorting and grading, testing, and marking criteria for the batteries that are to be used in a new battery assembly. This standard is used for a facility process certification similar to ISO 9001. A battery that goes through this process is not a listed battery unless it is additionally evaluated to a safety standard such as UL 1973.

A.9.4.2 This section includes requirements designed to keep fires originating in a single energy storage unit from easily spreading to adjacent energy storage units or out of the fire area in which the ESS is installed. This is done by limiting potential fire size within an individual energy storage unit by limiting the total energy capacity of individual units. It also reduces the potential of fire originating in one unit from igniting an adjacent unit, or breaching a fire-resistance-rated wall through radiant heat transfer by requiring spacing between individual energy storage units, and between units and walls. An option is provided for increasing individual unit energy capacity or reducing spacing by successfully passing fire and explosion testing in accordance with 9.1.5.

The following two levels of compliance can be considered with regards to size and separation:

(1) The ESS meets the group size and separation requirements of 9.4.2.1 and 9.4.2.2.

(2) The ESS exceeds the group size limit of 9.4.2.1, or has spacings smaller than 9.4.2.2, but remains constrained to the limits determined by the fire and explosion testing of 9.1.5. This option is based on the review and acceptance of test data by the AHJ as required by 9.4.2.3.

N **A.9.4.2.4.1** Paragraph 9.4.2.4.1 aligns with 90.2(D)(4) of *NFPA 70*.

A.9.4.2.4.2 This is in line with the scope of 90.2(D)(5) of *NFPA 70* and applies to lead-acid or nickel-cadmium batteries.

A.9.5.1.2.1 An occupied work center is typically an area in which stationary battery systems are provided in an electronic equipment or computer room with occupiable space. Personnel in these locations are not responsible for maintaining or servicing the battery systems. The requirements in this section are provided to help ensure their safety and the safety of emergency responders dispatched to the work area.

A.9.5.2.3.2 Walk-in ESS are units where personnel can enter the enclosure or container housing the system or system components for any reason. This includes ESS enclosed within an outer enclosure similar to an ISO shipping container. It does not include ESS cabinets where personnel can partially enter into the outer enclosure to perform service or maintenance.

N **A.9.5.3.1.1.3(3)** This item addresses concerns related to radiant energy on nearby flammable components such as batteries under a PV array. UL 9540A fire testing should be done on a representative installation configuration. Other siting considerations include minimum distances, installation instructions, or relevant safety standards that might address this new application of ESS such as UL 2703, which covers the fire rating of the PV system (i.e., PV modules, racking, and roofing) and might need to consider the effect of additional components in the testing.

N **A.9.6.2.2.3** Paragraph 9.6.2.2.3 is in line with the scope of 90.2(D)(5) of *NFPA 70*.

N **A.9.6.3.2.1** Paragraph 9.6.3.2.1 aligns with 90.2(D)(4) of *NFPA 70*.

Δ **A.9.6.5.1** This section addresses hazards associated with the release of flammable gases from ESS during normal charging, discharging, and use conditions. Similar requirements have been in fire codes for many years primarily to address off-gassing of hydrogen from stationary vented lead-acid battery systems but not limited to that technology.

This section is not intended to provide protection against the release of flammable gases during abnormal charging or thermal runaway conditions. Those conditions are addressed in 9.6.5.6. In addition, this section does not regulate ventilation of toxic and highly toxic gases, which are regulated by 4.6.11.

A.9.6.5.1.4 Initial charging of new batteries can produce more hydrogen than operational boost charging. It is advisable to calculate or obtain hydrogen production numbers for this operational mode and determine if existing ventilation is adequate or temporary supplemental ventilation is needed. See IEEE 1635/ASHRAE 21, which covers the ventilation of stationary battery systems utilizing vented (flooded) lead-acid, valve-regulated lead-acid (VRLA), and nickel-cadmium (Ni-Cad) batteries.

N **A.9.6.5.1.5.4** Possible standards to which gas detectors might be approved or listed include UL 2075 and FM 6325.

The purpose of the gas detector is to initiate ventilation that will remove flammable gases from the installation area before a flammable atmosphere is reached. Note that for most lead-acid and Ni-Cd installations, calculated hydrogen release under normal float charging or even boost charging is relatively small and easily handled by normal occupancy type ventilation requirements, therefore use of a hydrogen detector for these spaces is often not even recommended (see IEEE 1635/ASHRAE 21). If a gas detector is used, its selection and location should be analyzed with the following considerations:

(1) Detected gas
(2) Response time
(3) Ambient airflow
(4) Vulnerability to fouling, poisoning, or drift
(5) Required maintenance

Detected Gas. The detector should be selected to sense hydrogen since this is the only flammable gas that aqueous batteries (e.g., lead-acid, Ni-Cd, Ni-Zn) release under normal operation. Nonaqueous technologies, like lithium-ion and NaNiCl, do not normally release gas except for under thermal runaway conditions. See 9.6.5.6 for ventilation recommendations for abnormal conditions like thermal runaway.

Response Time. The detector should be selected to minimize the response time to initiate ventilation. Factors that can impact response time include the distance for the air–gas mixture to travel to the detector, the length of the sample tube (if applicable), the type of detector, and the analysis process. Detectors can be listed with response times of under a minute to several minutes. Because hydrogen molecules—being small—disperse fairly quickly and spread relatively evenly throughout the environment, and because the alarming and action threshold is at 25 percent of the LFL (and the LEL is even higher than the LFL by at least a factor of 2), hydrogen sensors should be placed between 1 m to 2 m (3 ft to 6 ft) from the battery vents to avoid unnecessary alarms and in accordance with the battery manufacturer's instructions.

Ambient Airflow. There are several documents that provide qualitative guidance on the number and location of gas detectors in process areas (e.g., EN 60079-29-16-1), performance requirements of detectors for flammable gases (e.g., ISA TR84.00.07), and monitoring for hazardous material release (e.g., CCPS publication *Continuous Monitoring for Hazardous Material Releases*). These documents provide guidance on the most common approaches to gas detector placement, including target gas cloud and scenario-based monitoring.

Vulnerability to Fouling, Poisoning, and Drift. Note that not all combustible and toxic gas–sensing technologies are equal. Some are more sensitive than others to fouling (i.e., misreading and/or failure) from cross-contamination with other gases that might be present. Note that the largest quantities of gases produced during a lithium-ion fire are hydrogen, carbon monoxide, and carbon dioxide. The environment where the ESS is installed should be assessed to determine the likely presence of any other gases that could foul or poison a catalytic bead–type sensor or an electrochemical detector. The sampling tube size, where used, should consider particulate concentration in the ambient that could clog the tube if not maintained regularly. Some detectors must be "bump tested"—exposed to a small amount of the calibration gas—to ensure the sensor continues to sense the target gas at the desired concentration.

Required Maintenance. All detectors require routine maintenance to ensure continued proper function. The manufacturer's guidelines should be followed for regular calibration, bump testing (if needed), and sample tube cleaning. The recommended intervals for such maintenance vary from 1 to

12 months, depending on the type and manufacturer of the device. Designers and installers should ensure that end users are aware of the maintenance requirements and manufacturer's instructions. Calibration should only be conducted by qualified personnel, and only with the target gas.

Note that because hydrogen molecules are very small, they tend to disperse rapidly. Hydrogen will initially head to the ceiling. Research by NIST (see GCR-10-929), Sandia National Labs (see SAND2019-7454C), the Netherlands Institute for Safety (see IFV 20210209), and many others indicates that gas concentration will be detectable throughout the room over a reasonable time period; therefore, placement of the hydrogen sensors should be at an easily-accessible location in the battery area [within 2 m (6 ft) of the batteries] instead of near a high ceiling in order to facilitate the relatively frequent maintenance required for the sensors.

A.9.6.5.2.2 Methods of achieving this protection can include, but are not limited to, the following:

(1) Liquidtight sloped or recessed floors in indoor locations or similar areas in outdoor locations
(2) Liquidtight floors in indoor locations or similar areas in outdoor locations provided with liquidtight raised or recessed sills or dikes
(3) Sumps and collection systems

A.9.6.5.3.1 One method to determine compliance with the neutralization requirements of this subsection is found in UL Subject 2436. UL Subject 2436 investigates the liquid tightness, level of electrolyte absorption, pH neutralization capability, and flame spread resistance of spill containment systems.

N **A.9.6.5.4** If recombination caps are used they should contain evaluated flame arresters.

N **A.9.6.5.5** A component of the thermal runaway protection might be integrated within the ESS battery management system or ESS management system that controls the charging and discharging to keep the ESS within its normal/safe operating limits when that device has been evaluated with the batteries or capacitors as part of the listing to UL 1973 or UL 9540, as applicable. The device might also initiate appropriate hazard mitigation as required elsewhere in this standard when the ESS is in an abnormal state such as overheating or off-gassing.

Δ **A.9.6.5.6** During failure conditions such as thermal runaway, fire, and abnormal faults, some ESS, in particular electrochemical batteries and capacitors, begin off-gassing flammable and toxic gases, which can include mixtures of CO, H_2, ethylene, methane, benzene, HF, HCl, and HCN. Among other things, these gases present an explosion hazard that needs to be mitigated. Explosion control is provided to mitigate this hazard.

Both the exhaust ventilation requirements of 9.6.5.1 and the explosion control requirements of 9.6.5.6 are designed to mitigate hazards associated with the release of flammable gases in battery rooms, ESS cabinets, and ESS walk-in units. The difference is that exhaust ventilation is intended to provide protection for flammable gases released during normal charging and discharging of battery systems since some electrochemical ESS technologies such as vented lead-acid batteries release hydrogen when charging.

In comparison, the 9.6.5.6 provisions are designed to provide protection for electrochemical ESS during an abnormal condition, such as thermal runaway, which can be instigated by physical damage, overcharging, short circuiting, and overheating of technologies such as lithium-ion batteries, which do not release detectable amounts of flammable gas during normal charging and discharging but can release significant quantities of flammable gas during a thermal event.

Δ **A.9.6.5.6.3** The requirement recognizes that with some cabinet designs that have low internal volume, the application of NFPA 68 or NFPA 69 might not be practical. It is possible that a quantitative explosion analysis is necessary to show there is no threat to life and safety. For example, the cabinet design might be installed such that any overpressure due to ignition of gases and vapors released from cells in thermal runaway within the enclosure are released to the exterior of the enclosure. There should be no uncontrolled release of overpressure of the enclosure. All debris, shrapnel, or pieces of the enclosure ejected from the system should be controlled. The UL 9540A unit level and installation level test identified in 9.1.5 will provide the test data referenced in 9.6.5.6.3, which is necessary for verification of the adequacy of the engineered deflagration safety of the cabinet.

NFPA 68 applies to the design, location, installation, maintenance, and use of devices and systems that vent the combustion gases and pressures resulting from a deflagration within an enclosure so that structural and mechanical damage is minimized, and provides criteria for design, installation, and maintenance of deflagration vents and associated components. NFPA 68 does not apply to detonations. Hydrogen accumulation in a confined space can lead to a detonation. For that reason, the combustion gases generated during the cell, module, and installation level testing under UL 9540A must be used when applying a NFPA 68 solution. Where the likelihood for detonation exists, alternative solutions such as those in NFPA 69 should be considered.

NFPA 69 applies to the design, installation, operation, maintenance, and testing of systems for the prevention of explosions in enclosures that contain flammable concentrations of flammable gases, vapors, mists, dusts, or hybrid mixtures by means of the following methods:

(1) Control of oxidant concentration
(2) Control of combustible concentration
(3) Pre-deflagration detection and control of ignition sources
(4) Explosion suppression
(5) Active isolation
(6) Passive isolation
(7) Deflagration pressure containment
(8) Passive explosion suppression

Combustible gas concentration reduction can be a viable mitigation strategy for possible accumulation of flammable gases during abnormal conditions for lithium-ion batteries. Gas detection and appropriate interlocks can be used based on appropriate evaluation under an NFPA 69 deflagration hazard study. NFPA 69 allows concentration to exceed 25 percent LFL but not more than 60 percent with reliable gas detection and exhaust interlocks as demonstrated by a safety integrity level (SIL) 2 instrumented safety system rating.

Data on flammable gas composition and release rates, such as that included in UL 9540A fire and explosion testing, provide the information needed to design effective explosion control systems.

N **A.9.6.5.6.4** Currently, UL 9540A includes a pass/fail criteria requiring that no hazardous pressure waves, debris, shrapnel,

or enclosure pieces are ejected during the fire and explosion testing. Engineered solutions might be an effective solution to the deflagration hazard, and engineering details are to be submitted for review and evaluation by laboratory staff prior to testing.

Hazardous pressure wave guidance for human exposure and structure exposure can be found in NFPA 921 and in a City University of New York (CUNY) guidance document found at nysolarmap.com/media/2041/fire-safety-testing-data-analysis-supplement-for-nyc-outdoor-ess_v1.pdf. For human and structure exposure, a level less than 1 psig (6.9 kPa) might be indicated by the guidance material.

N **A.9.6.5.6.6** Possible standards to which gas detectors might be approved or listed include UL 2075 and FM 6325.

The purpose of the gas detector is to initiate ventilation that will remove flammable gases from the installation area before a flammable atmosphere is reached. Data from lithium-ion battery and module testing indicates that gas generation accelerates rapidly once the thermal runaway threshold is reached. Therefore, it is critical to initiate ventilation as early in the process as possible. Selection and location of the gas detector should be analyzed with the following considerations:

(1) Detected gas
(2) Response time
(3) Ambient airflow
(4) Vulnerability to fouling, poisoning, or drift
(5) Required maintenance

Detected Gas. The detector should be selected to sense a gas that is likely to be present in the event of thermal runaway and in high enough quantities that the event will be identified in a timely manner. Note that while hydrogen is the primary combustible gas of concern for aqueous batteries (e.g., lead-acid, Ni-Cd, Ni-Zn), for lithium-ion batteries, multiple combustible gases are released in a thermal runaway/fire scenario. Hydrogen is usually the predominant gas generated, but significantly measurable quantities of methane, ethane, propylene, and ethylene are also produced along with trace amounts of other hydrocarbon combustible gasses (the actual mixture and percentages of combustible gases depends on the lithium-ion chemistry).

Response Time. The detector should be selected to minimize the response time to initiate ventilation. Factors that can impact response time include the distance for the air–gas mixture to travel to the detector, the length of the sample tube (if applicable), the type of detector, and the analysis process. Detectors can be listed with response times of under a minute to several minutes. Because gas generation is known to increase over the course of a thermal runaway event, the response time of the detector itself should be in the one to three minute range.

Ambient Airflow. There are several documents that provide qualitative guidance on the number and location of gas detectors in process areas (e.g., EN 60079-29-16-1), performance requirements of detectors for flammable gases (e.g., ISA TR84.00.07), and monitoring for hazardous material release (e.g., CCPS publication *Continuous Monitoring for Hazardous Material Releases*). These documents provide guidance on the most common approaches to gas detector placement, including target gas cloud and scenario-based monitoring.

The role of airflow, particularly in "open" ESS rooms and buildings, will greatly impact the location of detectors. Many LIB installations require constant ventilation to maintain batteries within the normal operating temperature range. In indoor installation areas, the airflow patterns will be determined by the mechanical ventilation system. In these cases, there will be an exhaust or recirculation duct where well-mixed air will come in contact with the gas detector. In smaller installations, or where multiple ventilation ducts are used, detector placement in the exhaust duct could provide the best chance for rapid detection. In large installations, this might not be the ideal or the only location for a gas detector due to the longer travel time for gas mixtures from the furthest unit to reach the duct. Additional detectors arranged in a grid pattern could be recommended.

Vulnerability to Fouling, Poisoning, and Drift. Note that not all combustible and toxic gas–sensing technologies are equal. Some are more sensitive than others to fouling (i.e., misreading and/or failure) from cross-contamination with other gases that might be present. Note that the largest quantities of gases produced during a lithium-ion fire are hydrogen, carbon monoxide, and carbon dioxide. The environment where the ESS is installed should be assessed to determine the likely presence of any other gases that could foul or poison a catalytic bead–type sensor or an electrochemical detector. The sampling tube size, where used, should consider particulate concentration in the ambient that could clog the tube if not maintained regularly. Some detectors must be "bump tested"—exposed to a small amount of the calibration gas—to ensure the sensor continues to sense the target gas at the desired concentration.

Required Maintenance. All detectors require routine maintenance to ensure continued proper function. The manufacturer's guidelines should be followed for regular calibration, bump testing (if needed), and sample tube cleaning. The recommended intervals for such maintenance vary from 1 to 12 months, depending on the type and manufacturer of the device. Designers and installers should ensure that end users are aware of the maintenance requirements and manufacturer's instructions. Calibration should only be conducted by qualified personnel, and only with the target gas.

N **A.9.6.6.1** Authorized service personnel should be guided by the decommissioning plan (see Section 8.1) with guidance from the emergency responders to safely mitigate any hazard created by the damage to the ESS. The authorized service personnel should be dispatched in a time established by the AHJ. This should be made a provision of the AHJ operating permit.

N **A.9.6.6.2** For example, lithium-ion batteries in ESS that experience an abnormal condition, including thermal runaway, might experience reignition even though the initial fire event appears to have been extinguished. Hazard support personnel are needed on-site during this period to monitor and control the ESS and batteries until they can be placed in a safe condition. During this time, it might be appropriate to apply water for cooling and to provide ventilation. Without these measures, it is possible for heat to remain and for thermal runaway reactions to continue occurring.

This occurrence has been observed multiple times. A best practice is for the AHJ to require a fire watch by a trained person described as "hazard support personnel" that will make sure that all safety precautions and mitigation practices in place are followed. This is intended to protect the public and the

building occupants from these potential fire and explosion hazards that could still exist after the initial fire is considered to be extinguished.

The ESS location should be a factor in determining whether a fire watch at the site is necessary, based on a risk assessment and the site decommissioning plan. If a fire watch is not required, the site should still be protected from any unauthorized access because even damaged ESS could still have dangerous levels of stored electrical energy.

Where an ESS is damaged by fire, the engineering safety measures that are provided for the ESS are compromised and might no longer provide the safety that is provided during normal ESS operation.

N **A.9.6.6.2.1** The following hazard support personnel qualifications should be considered:

(1) Trained by the ESS provider about the hazards of the ESS to be monitored
(2) Knowledgeable with the ESS fire protection features
(3) Knowledgeable with the manufacturer's emergency guide and how to access the battery

N **A.9.6.6.2.4** Based on the system design and features, remote monitoring and controls that provide additional safety benefits can be used by the AHJ to determine the level of onsite monitoring required.

N **A.9.6.6.2.5** Hazard support personnel should be able to provide support to the AHJ in reoccupying the space, implementing the decommissioning plan, and deenergizing the battery modules for a safe means of transportation.

Hazard support personnel are not expected to perform any fire suppression duties but can do so if properly trained and equipped.

N **A.13.1.2** FESSs utilized exclusively on utility property under the jurisdiction of that utility would be evaluated to NFPA 850 as well as IEEE C2 and need not be covered by this installation standard.

N **A.13.1.3** An FESS requires ongoing inspections and maintenance that might not occur with an individual homeowner installation. A microgrid serving multiple dwellings assumes that required maintenance will be performed. Therefore, an FESS can be used as part of a multi-dwelling microgrid such as a neighborhood community solar installation.

N **A.13.2.5** Locations subject to high levels of vibration, such as near train tracks or large engine generators) can result in stress to the bearing systems and affect the safe operation of the FESS.

N **A.13.2.6** There should be capability for the ESMS to track the bearing replacement based upon length of date in service or usage (whichever comes first) and that incorporates the time the bearings are without magnetic unloading, which can reduce bearing life. The bearing monitoring can be part of the flywheel control system.

N **A.13.2.6.2** ESMS data on temperature and vibration should be stored for postfailure analysis.

N **A.13.2.8** FESS containment measures can consist of the following two methods:

(1) Containment of the rotor
(2) A rotor design margin with stringent rotor screening in production, including sacrificial evaluation of rotors

The containment of hazardous moving parts is evaluated as part of the listing evaluation and can be provided by the installation.

The evaluation of containment should consider whether the enclosure can become pressurized during a catastrophic failure of a flywheel. In some flywheel designs, the rapid dissipation of kinetic energy into heat during rotor failure can heat liquids or other components in the housing and generate pressure. The flywheel enclosure could potentially burst if not designed to contain this pressure or equipped with pressure relief devices.

Failure of a composite flywheel can generate particulate, which can be a combustible dust. See NFPA 652 for general guidance on managing hazards of combustible dust.

N **A.13.2.9** Some FESS can be used in a mobile application, but the rotor would need to be stopped prior to moving. Mobile FESS cannot be transported with energy in the flywheel.

N **A.13.2.12** Parts or other debris from catastrophic failure of a flywheel could damage adjacent flywheels or energy storage systems if the housing does not fully contain the failure.

N **A.13.3** Prior to operating the FESS, the following should be verified to ensure that the bolts securing the FESS are the correct grade and size, and are all torqued to specification; the concrete inserts are the correct type; the concrete support is the appropriate thickness (validate with personnel that did the coring); and the proper mechanical containment was installed, if required. As part of this process, the securement of the bolts should be reverified to ensure that they are tightened to the appropriate torque.

N **A.13.4** The bearing change interval can be either periodic or reported by the system. If reported by the system, it should be based upon actual bearing condition.

N **A.13.4.2** Vacuum leaks often get worse over time and a leak should be dealt with preemptively. With some designs of FESS, a sudden loss of vacuum can result in a rotor failure.

N **A.13.5.1** Discharging the FESS to 100 percent usually does not accomplish a complete removal of energy. In the event of a tachometer/commutation sensor feedback failure, no indication of rotor speed will be available. Flywheels can take more than 24 hours to spin down to zero rpm.

N **A.14.2.1** Batteries have been safely collected in one or two 55 gal (208 L) drums (or similarly sized bins or containers) for decades without any significant fire or life safety events.

Δ **A.15.1** Any detached building, or any part of a townhouse structure that is separated from the remainder of the townhouse structure with fire resistance rated assemblies in accordance with local building code, that contains no more than two dwelling units intended to be used, rented, leased, let, or hired out to be occupied or that are occupied for habitation purposes. [**13D:**3.3.3]

A.15.5.4 The batteries on electric vehicles should not be included in the aggregate energy capacity limitations in 15.4.1.

N **A.15.6.2** In addition to the system connection equipment needing to be listed for utility connection, the installer needs to be aware of and comply with the local utility interconnection requirements.

N **A.15.12** The test report will provide information that, among other things, describes the size and energy capacity rating of the unit being tested, model numbers of the modules and ESS units, orientation of ESS in the test facility, and proximity of the ESS unit under test to adjacent ESS, walls, and monitoring sensors. The test report also includes a complete set of test results and measurements. For example, a complete UL 9540A test report that includes a unit-level test should also include the UL 9540A cell and module-level test.

N **A.15.13.1** A UL 9540A or equivalent test should evaluate the fire characteristics of the composition of gases generated at the cell, module, and unit and installation levels for ESS undergoing thermal runaways, such as what might occur due to a fault, physical damage, or exposure hazard. The evaluation of the fire characteristics during fire vent testing at the unit-level and installation-level testing should document whether the fire event propagates to the neighboring ESS units and include radiant heat flux measurements at enclosing wall surfaces and at various distances from the ESS being tested at the unit level. The fire and explosion testing data is intended to be used by manufacturers, system designers, and AHJs to determine if the required separation distance for an ESS installation can be reduced.

N **A.15.13.1.4** Changes in an installation configuration, including the internal architecture of modules and units that don't match the parameters tested, such as size and separation, cell type, or energy density, should only be accepted if it can be shown that the configuration provides equivalent results. For example, scaling such as height, depth, and spacing need to conform to the configuration of the test. Changes also might include multiple levels of units on top of each other, located on a mezzanine floor above, or back-to-back units. These configurations might have yet to be evaluated in the test.

Annex B Battery Energy Storage System Hazards

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 General Introduction. Battery energy storage systems (ESS) that are designed with sufficient safety protections and are installed, operated, and maintained in a manner that maintains the system safety can be operated without incident as evidenced by the systems currently operating safely in the field. The safety controls and hazard mitigation approach needs to consider the inherent hazards associated with these systems, which can vary depending on the battery technology.

B.2 Hazards Concerns.

B.2.1 The hazards that need to be addressed for ESS are fire and explosion hazards, chemical hazards, electrical hazards, stranded or stored energy hazards, and physical hazards. These hazards can vary by technology but can also vary under normal operating conditions compared with emergency and abnormal conditions.

B.2.2 The potential for fire hazards can be evaluated through control of the elements of the fire triangle. These elements are the fuel for the fire, the oxidant, and the ignition source heat. There is no potential for fire unless there is an appropriate concentration of fuel, oxidant, and a heat source sufficient to ignite the concentration.

B.2.3 Chemical hazards are categorized in accordance with OSHA/NIOSH hazardous materials limits for normal operation of the ESS and NFPA 704 for ESS involved in a fire or other emergency incident.

B.2.4 Electrical hazards for persons working with ESS where they might come in contact with energized parts greater than 50 V and exposed to arcing of electric energy with an incident energy level of 1.2 cal/cm^2 (5 J/cm^2) (potential to cause second-degree burns on skin), are electrical shock and arc flash as identified in *NFPA 70E*. Electrical hazards to emergency responders from ESS that have been exposed to fire or other emergency incidents need to be addressed, including the potential for arc faults and shock hazards due to shorting from damaged parts and water. Since first responders are not trained electrical workers and might not have appropriate PPE for direct contact with live parts or arc flash incidents, acceptable levels of voltage and incident energy need to be reduced from that allowed for trained workers with suitable PPE.

B.2.5 The term *stranded or stored* energy refers to unquantified hazardous levels of electrical energy that can be contained in all or part of an ESS, including one that has been damaged and/or thought to be discharged and that represents a hazard to persons in contact with the system, who are unaware of the hazardous energy. Since this hazard represents a potential unquantified electrical hazard, the allowed levels will be different depending on whether it pertains to normal conditions for repair and replacement by trained workers or for emergency responders dealing with damaged ESS that can still contain hazardous energy.

B.2.6 Physical hazards are hazards to persons that can occur from contact with parts having sufficient kinetic energy, parts that have hazardous thermal characteristics that can cause burns, or parts that contain fluids at hazardous pressure levels with either insufficient structural integrity to safely contain the fluids or the ability to safely relieve the pressure. For electrochemical ESS, the potential exists for burn hazards to workers in contact with some technologies during normal operation and repair, if not properly thermally insulated.

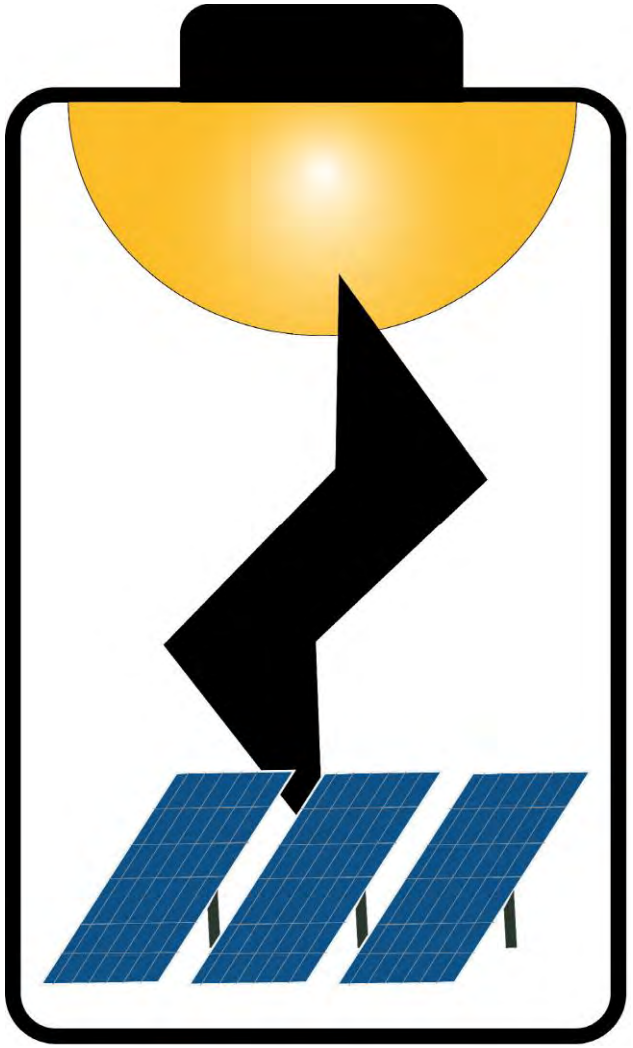
B.2.7 There are no known high-pressure hazards with these systems under normal operations, but under abnormal conditions, there can be overpressurization due to overheating of contents, which can result in a physical hazard. This could present a hazard to first responders dealing with damaged ESS. There are also no kinetic energy hazards associated with commercially available battery ESS, except for moving parts in the balance of plant components of the system that might not be properly guarded, such as cooling or ventilation fan blades.

B.3 Hazard Considerations Under Normal Operating Conditions.

B.3.1 Fire and Explosive Hazards. Fire and explosive hazards under normal operating conditions can be due to heat sources such as live parts, and so forth, that can be in contact with combustible materials during service or maintenance or to ignition of combustible concentrations or flammable fluids and solids that can occur as part of the normal operation of ESS, such as hydrogen off-gassing from batteries with aqueous electrolytes that are open to the atmosphere.

B.3.2 Chemical Hazards. Under normal operating conditions, the potential exists for exposure to hazardous materials by workers in contact with the system for maintenance, repair,

Battery Energy Storage Systems



BESS 101

Safety and Community Impact

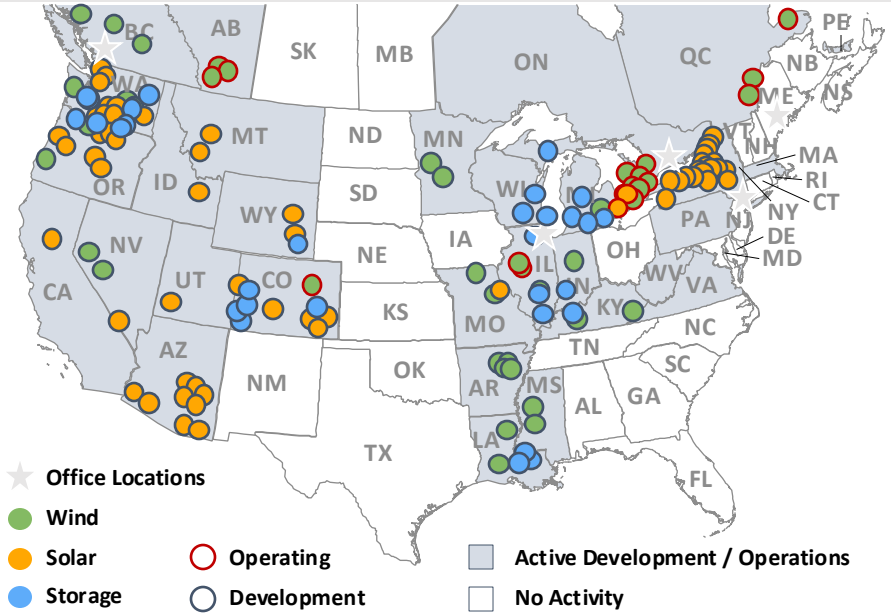
Land Use Approvals

October 2024

Presented by:
Erin Hazen
Vice President, Development
Cordelio Power
ehazen@cordeliopower.com

Cordelio Power | Company Overview

Overview of Operations and Growth

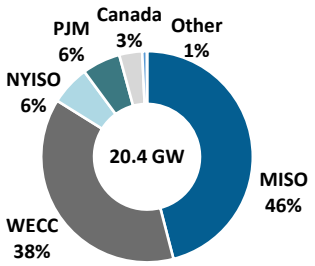


1. **Established IPP** — Currently operate net >1.4 GW of renewable assets across the U.S. & Canada
2. **250+ Years Experience** — Strong team experience developing, financing, and operating projects
3. **Selective Market Entry** — Growth focused in premium markets: MISO, WECC, NYISO, and PJM
4. **Strong Relationships** — Longstanding relationships with key financiers, offtakes, and suppliers
5. **Construction Expertise** — Have overseen E&C on ~500 MW of greenfield wind and BESS assets

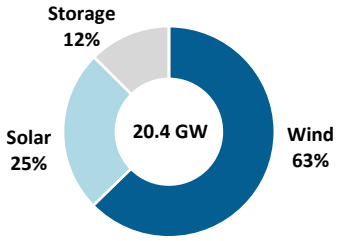
Cordelio Overview

CORDELIO POWER

116 *Development Projects* ***24*** *Operating Projects* ***140*** *Total Projects*



Market Composition (MW)



Breakdown by Technology (MW)

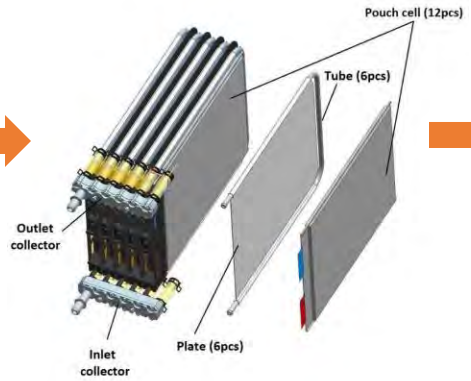
CPP Investments

- Cordelio is a wholly-owned subsidiary of the Canada Pension Plan Investment Board (CPP Investments), the independently governed investment manager of the Canada Pension Plan
- CPPIB managed ~C$591Bn in investment assets for the Canada Pension Plan as of December 31, 2023
- CPP Investments uses its scale and long-term investment horizon to competitively position itself in the power and renewables space, particularly focusing on low-carbon energy

Key Elements of a BESS Site

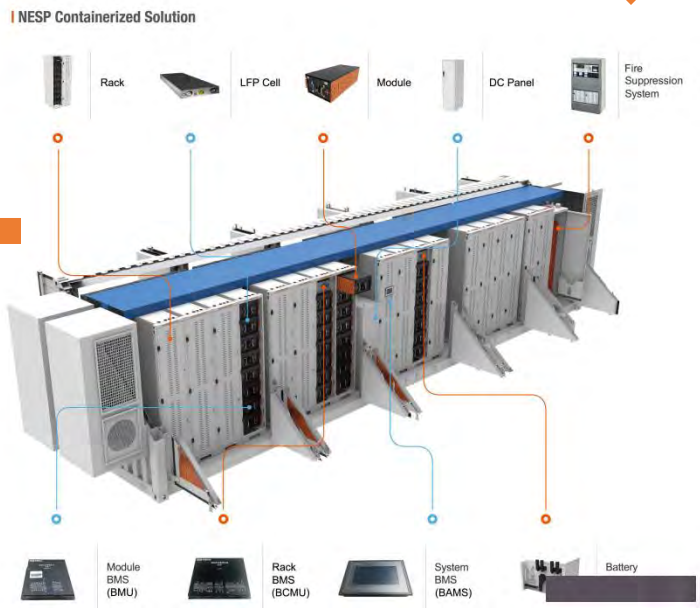
Build-up of a BESS Site

Cell



Module

Rack

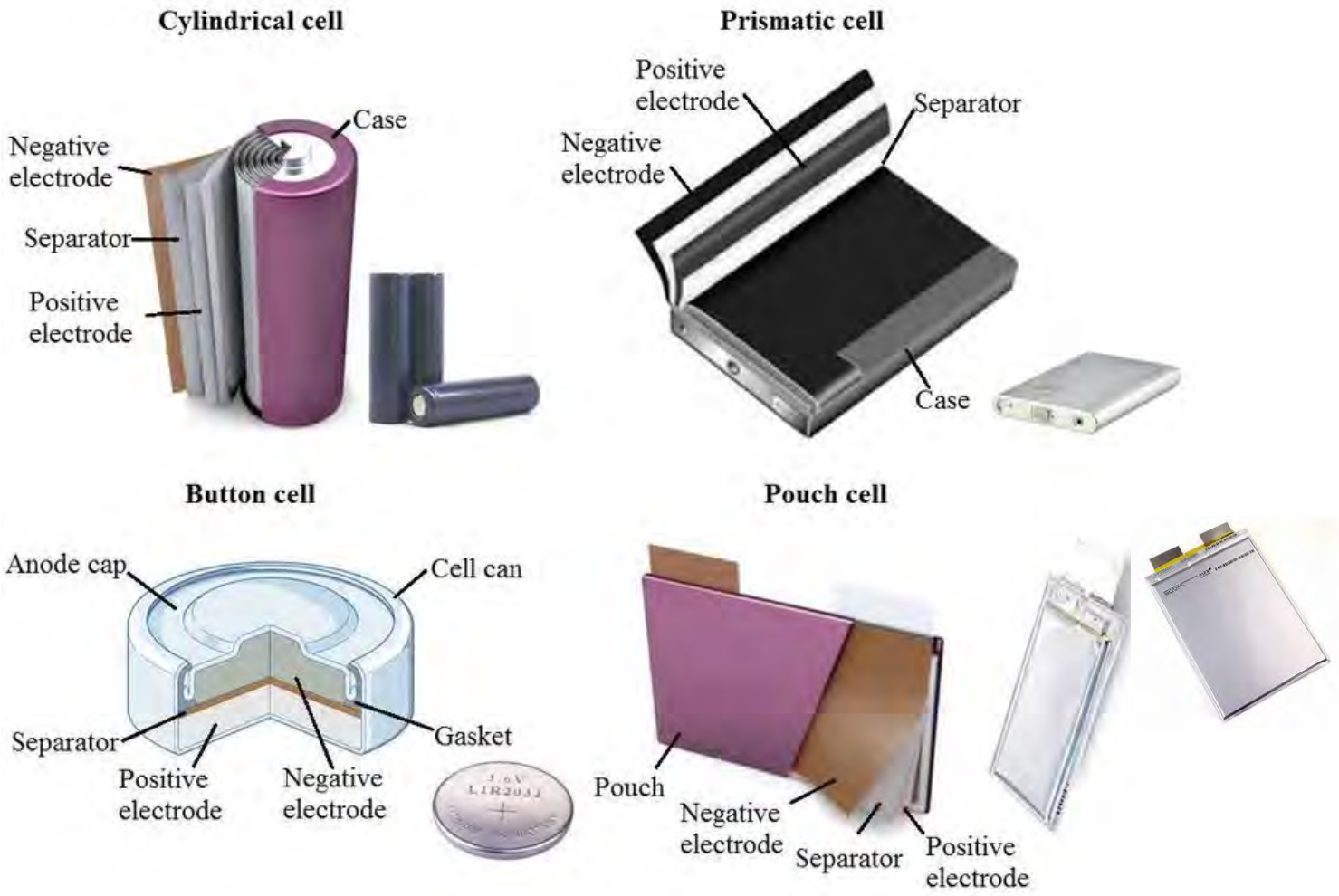


Container

Site

- Cell
- Module
- Rack -BMS
- Container - PCS/MVT
- Site - EMS - Telemetry

***Key cell components*: Positive electrode, negative electrode, separator, electrolyte.**



Cell

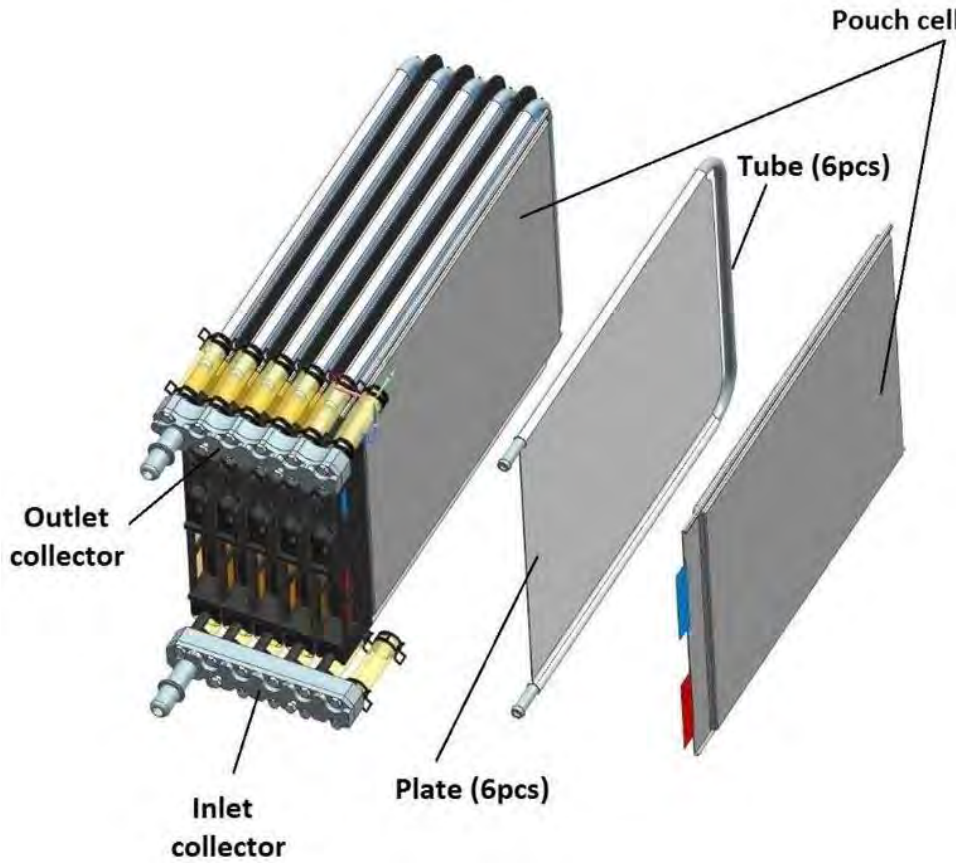
Module

Rack
-BMS

Container

- PCS/MVT

Site
- EMS
- Telemetry



Cell type	Module
Cylindrical	
Prismatic	
Pouch	

Current-day modules are made up of about 12 individual cells connected electrically to achieve the desired voltage and capacity.

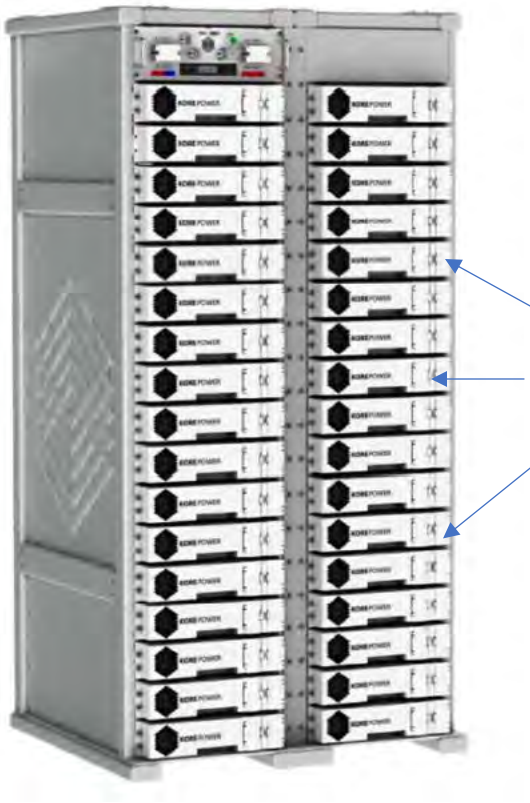
Cell

Module

Rack
-BMS

Container
- PCS/MVT

Site
- EMS
- Telemetry



Modules are grouped into frames to form racks.

*Racks typically contain **BMS** units, rack switchgear, and other control components.*

Cell

Module

Rack +BMS

Container

- PCS/MVT

Site

- EMS
- Telemetry

BMS – Battery Management System:

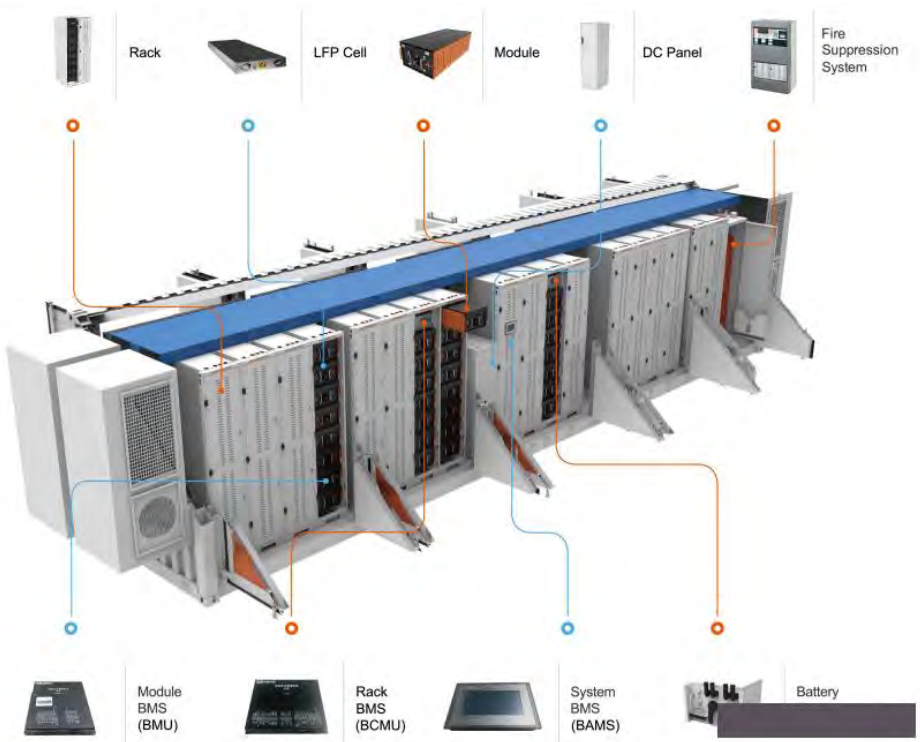
Provides critical management and monitoring to provide safe and reliable battery use.

Racks are combined into steel containers.

These containers are the site building blocks and each can store about 0.5 MWh.

Containers include:

- temperature control system; HVAC or liquid-cooling
- Fire suppression systems
- Gas detection system
- Placement of the inverter (PCS) varies by OEM. Some are inside container, others are external pad-mounts, others are combined with transformer cabinet



PCS – Power Conversion System

- AKA: inverter. Converts DC power to AC and vice versa.

MVT – Medium Voltage Transformer

- AKA: Generation Step-Up (GSU) transformer. Usually ~480-800V (inverter side) stepped up to ~34.5kV

Cell

Module

Rack
-BMS

Container
PCS/MVT

Site
- EMS
- Telemetry

Site is made up of container + PCS/MVT building blocks, auxiliary power equipment, communications/telemetry, EMS, protection/switchgear, circuit breaker, and metering

EMS – Energy Management System

Site controls (PPC)

- Coordinates work of BMS, PCS, and other components of the BESS

- SCADA
- Cyber security
- Market Participation/Bid analysis
- Performance Analytics
- Optimizations
- Monitor operations

Cell

Module

Rack
-BMS

Container

- PCS/MVT

Site
- EMS

Telemetry

Community Impacts

Tax Revenue

A BESS project is a significant taxpayer on compact footprint.

Poses no burden on schools, roads, water, sewer

In most jurisdictions, the steel enclosure and the batteries they hold qualify as business personal property. Batteries represent the majority of a project's capital cost.

Real property is limited to the foundations, control house, and site

AHJs need to pay attention to this distinction when considering how the project benefits tax revenue

Construction period : 6-10 months, plus 1-2 months of commissioning

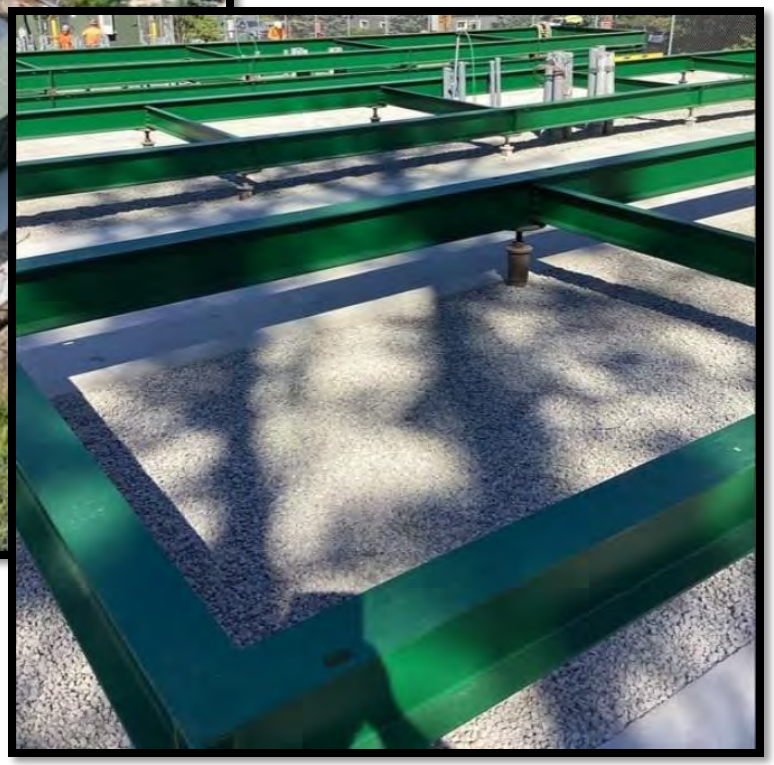
Local trades: earth moving/site work, concrete, cranes, fencing.

High voltage electrical work and substation construction may rely on specialized crews from outside local area

ITC Eligibility depends on Apprentices!

- Labor hours requirements: 12.5-15% of total construction performed by apprentices
- Strict journeyworkers-to-apprentice ratios

Containers are placed on concrete pads--or increasingly, on steel skid and helical piles



Typical spacing

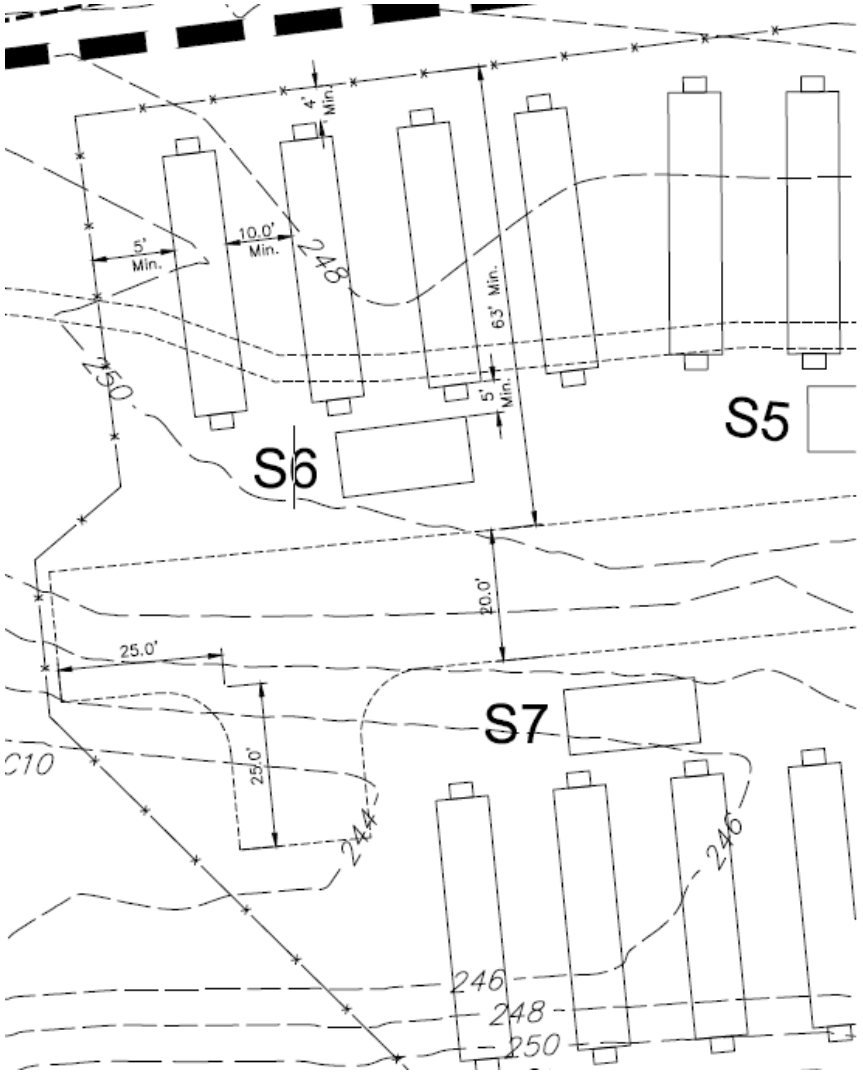
Battery enclosures usually 8.5-9ft high, 40-50ft long

Approx 10ft spacing between containers, 4-5ft clearance to any fence

Highly flexible layout options to fit site

Make sure developer's roads accommodate fire department turn radii, outriggers

Energy density continues to improve –current BESS on the market allow 80-120 MWh per acre



Some suppliers are working on stackable containers – not seeing these deployed yet

Security fencing topped with barbed wire required due to high voltage equipment, but can be made more attractive with privacy slats, plantings, landscaping

Battery enclosures can be generally hidden from ground-level view behind fences.

Projects usually include a small substation-- some of this structure will be taller than the fence

Minimal lighting required—reasonable to ask developers for dark sky compliance, no light trespass

Privacy Fence Example

Typical view from inside and outside the fence

Air-cooled BESS (typical OEM specs):
Measured at 3 feet from equipment
HVAC: 75 dBA
Inverters 79 dBA
Main Trainsformer: 82 dBA

Due to accretive effect of noise from grouped equipment, a group of battery enclosure and inverters can be expected to emit around 85-90 dBA

Decibels	Distance BESS to Receptor (ft)
90	3
84	6
78	12
72	24
66	48
60	96
54	**192**
48	**384**
42	768
36	1536
30	3072

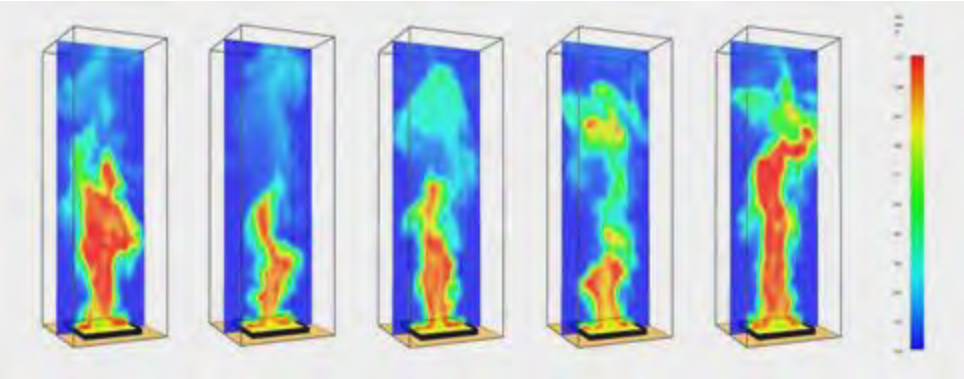
Distance is the best mitigation

Sound levels drop by 6 dBA over twice the distance traveled.
10dB reduction in sound = 50% reduction perceived “volume”

Hey Developers, Listen up!

Ensure proper siting to avoid community noise annoyance

Fire Hazard is usually #1 community concern



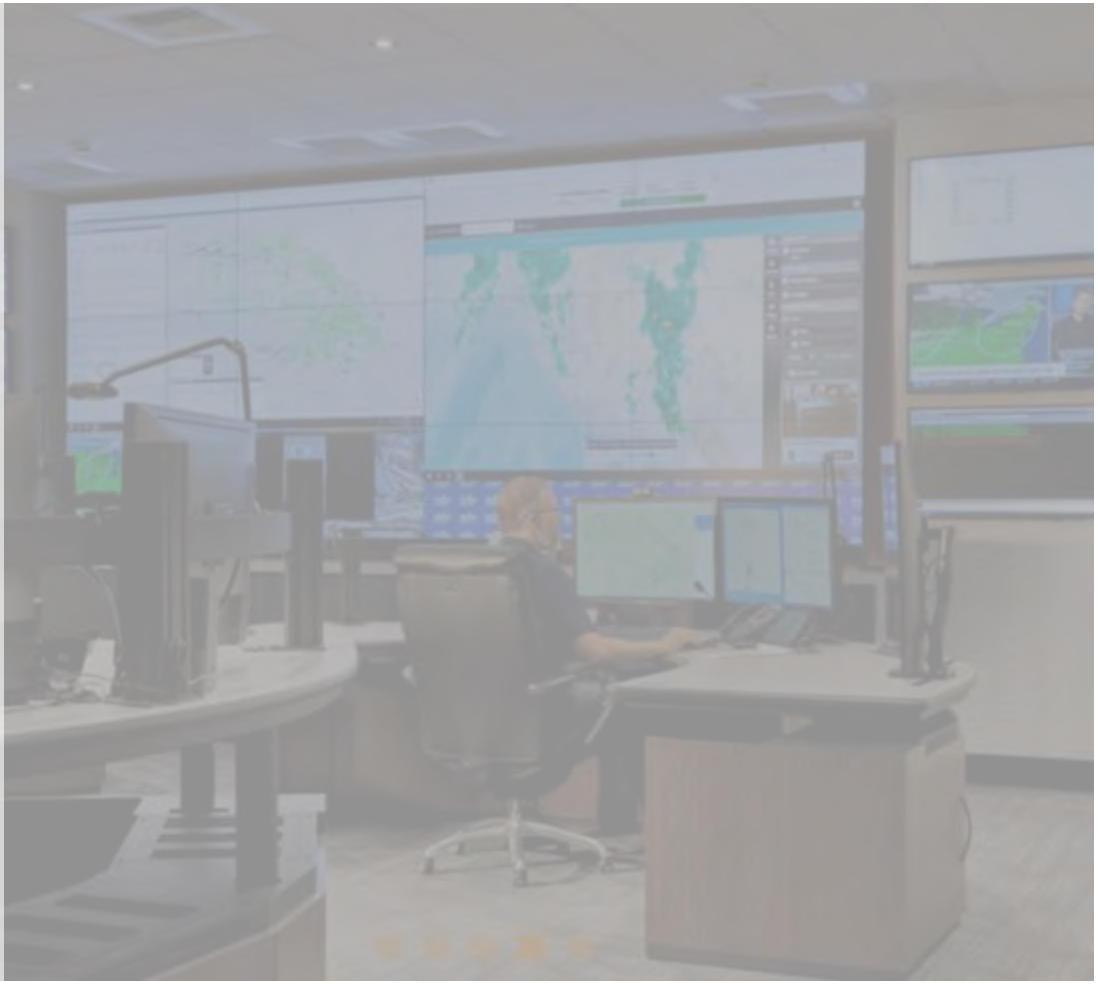
Successful developers….

- Learn UL9540(A) and educate community what it means
- Meet early & often with fire departments during development
- Provide access to fire safety experts
- Offer on-site fire department orientation training before COD and regularly thereafter
- Partner with high quality suppliers and learn their fire safety philosophy – it varies!

Remote Operations Centers have constant eyes on the facility

- ROC personnel can drill down to conditions of each container, rack, module and individual cell

AC POWER
REACTIVE POWER
FREQUENCY
POWER FACTOR
OUTPUT AMP 1A/1B/1C
OUTPUT VOLTS VAB/VBC/VCA
HEAT SINK TEMP
BATTERY SOC
SOH
DC VOLTS, DC AMPS
MAX/MIN CELL VOLTS
MAX/MIN CELL TEMP
MAX/MIN RACK SOC
CONTAINER TEMPERATURE, HUMIDITY
HVAC STATUS
GAS SNIFFERS
SMOKE, TEMP RATE OF RISE
DOOR ALARMS, GATE LOCKS



GROUND FAULT DETECTION - detect faults and disconnect the system before a serious problem occurs. Removing current from a defective cell usually sufficient to prevent incident escalation.

GAS SNIFFER – sensors detect the earliest evidence of off gas and can trigger preventative or mitigating measures (eg, cooling system activation and ventilation) before thermal runaway begins.

FAST STOP - utomatically triggered in response to incipient gas or smoke detection and sudden changes in battery operating parameters. Manual fast-stop can also be performed by operators or first responders.

FIRE ALARM SYSTEM- includes smoke and temperature detectors (which trigger external horn, strobe light, and F-stop), an external horn + strobe light, and an optional aerosol cannister.

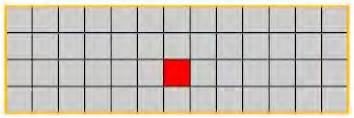
DEFLAGRATION PANELS- In the event of gas build-up, NFPA 68 Deflagration panels direct the force of an explosion upwards in the event of high pressure build up inside the container.

UL 9540A Fire Testing

Only the Minimum Number of Cells Are Heated to Initiate Thermal Runaway

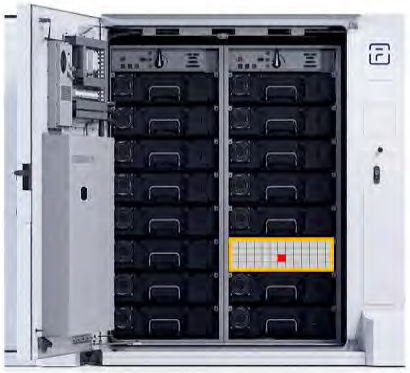
Cell-level Testing

One cell is heated.



Module-level Testing

The minimum number of cells are heated to create thermal runaway propagation within a battery module.



Unit-level Testing

The minimum number of cells are heated to create thermal runaway propagation within a battery module inside a fully populated enclosure.

Installation-level Testing

Same as unit-level test with the addition of fire suppression safety features deployed.

Cell-level off gas data

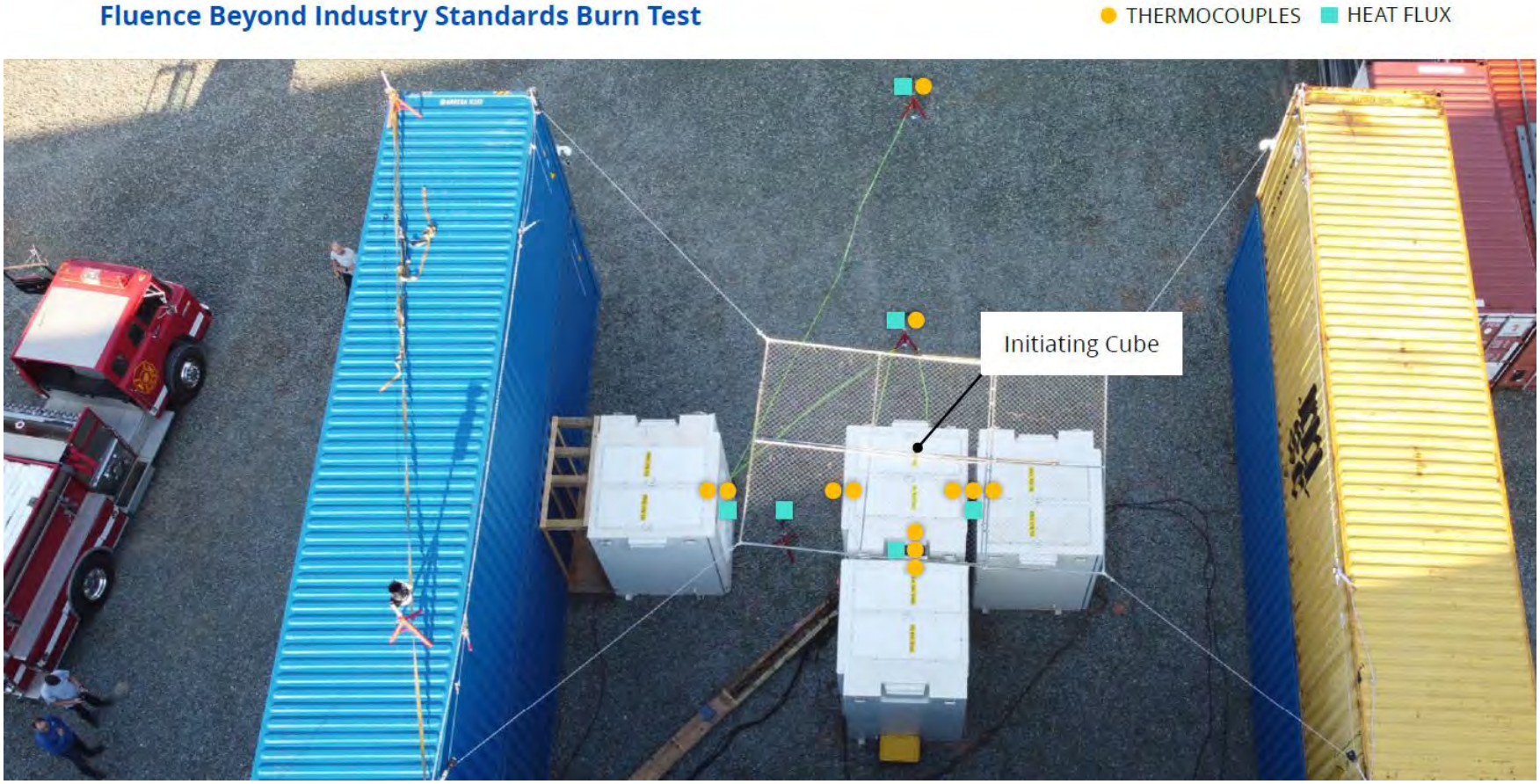
Number of cells forced into thermal runaway and total volume of off gas

- Product design (NFPA 68/69)
- CFD simulations
- Deflagration testing

Remember this number:
175° F

UL 9540(A) Unit –level Testing

Fluence Beyond Industry Standards Burn Test



Gas sampling hood

Continuous monitoring

- Oxygen sensor
- Standalone Flame Ionization Detector (FID) for total hydrocarbons
- Gas Chromatography Conductivity Detector (GCTCD) for hydrogen
- Fourier Transform Infrared (FTIR) for CO, CO2, acid gases, and alkycarbonates

Discreet Sampling

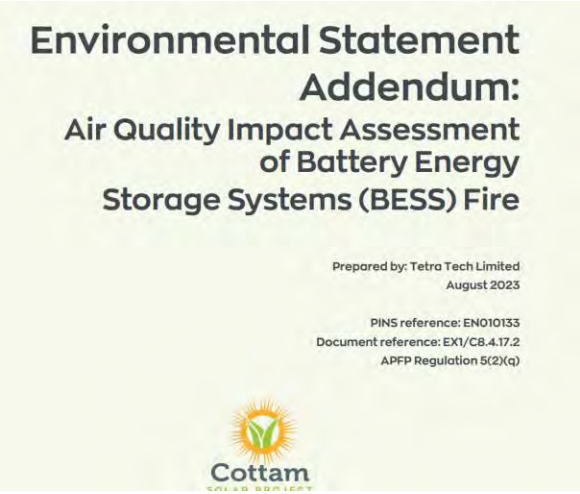
- Tedlar Bag
- Absorbent Tube
- Gas chromatography mass spectrometer (GCMS) for total gas composition

Look beyond the popular media headlines

TESLA & Fluence testing: Smoke constituents similar to Class A household fire

Fluence testing: Plume drift max: 80-100ft

Excellent report on air quality impacts of BESS fire by **Cottom Solar Project (UK):**


Environmental Statement Addendum:
Air Quality Impact Assessment of Battery Energy Storage Systems (BESS) Fire

Prepared by: Tetra Tech Limited
August 2023

PINS reference: EN010133
Document reference: EX1/C8.4.17.2
APFP Regulation 5(2)(q)

Cottam

Continuous improvement needed to reduce risk of thermal runaway…..

BUT…..
Numerous studies demonstrate that BESS is not a broad risk to community health

Ordinances

Many zoning paths for BESS approval

BESS ordinances remain uncommon but municipalities increasingly interested to enact

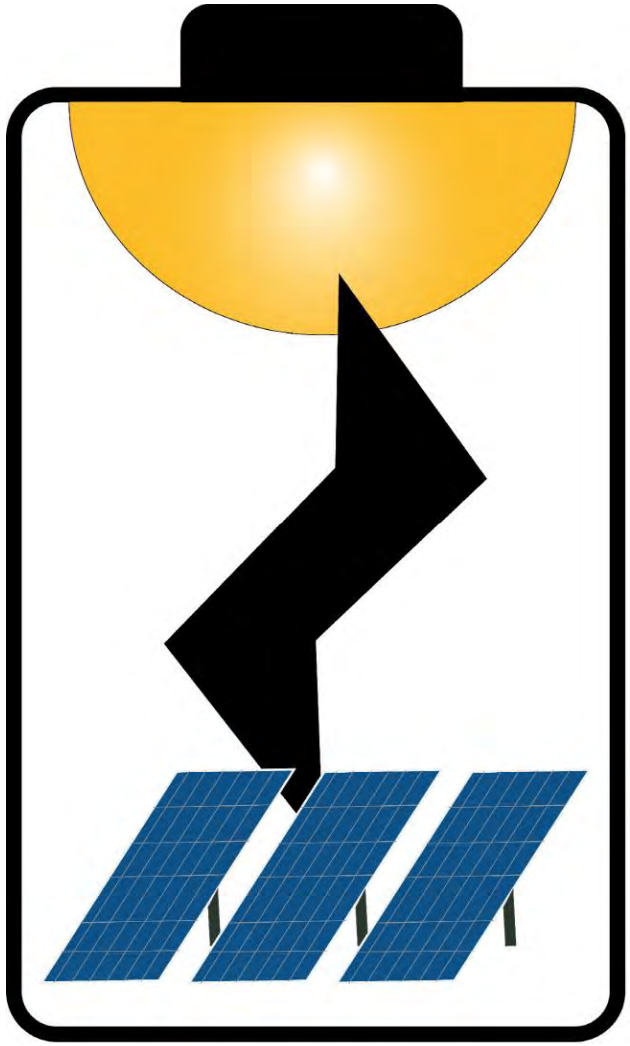
Some decent examples– tough but fair

- New York – NYSERDA's Model Law
- Johnson County, Iowa Ordinance 08-24-21-02

Tip: A utility electric substation is a good land use analog for BESS facilities in terms of function, safety, and community impact.

Makes sense for an ordinance to allow BESS as a Special Use in districts where electrical substations are permitted as a special use.

Battery Energy Storage Systems



BESS 101

Safety and Community Impact

Land Use Approvals

October 2024
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